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EDITORIAL

OIL AND HORSES

RECENT conferences, at a high international level, have drawn attention to the vital importance of oil in the economy of the modern world. Oil has become a prime factor in the supply of heat and energy in factories, in our homes and for transport. It bids fair to usurp the position held, so long, by coal. Coal was the fundamental requisite in the industrial revolution of the 19th century but the continued impetus of that motion seems to depend upon oil and so it will remain until an alternative, efficient, economic, and convenient source of energy is developed.

A firm which depends upon the production and sale of one product may profit well for a time, but the advent of an alternative or a change in the demands of the customers can bring disaster.

The world is in a similar position to-day. The sources of oil are not ubiquitous, the amount which is stored in the earth is not known, the effective life of any particular field cannot be prophesied with certainty and the consumers are dependent entirely on the goodwill of those responsible for production and transport. Producers or transporters can hold the consumer at ransom. These are some of the delicate circumstances which should deter those who might be persuaded to pledge their future upon a regular and ample supply of a source of energy that might be evanescent.

A wise man does not "put all his eggs in one basket." He orientates his business so that if one door should close, an alternative is available. In this

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manner he can ensure that calamity can be averted to some degree. For more than thirty years humanity has been the slave of the internal combustion engine which depends upon oil for its life. Oil has displaced other sources of energy which have served well in the past and this is most noticeable in the realms of traction. The use of oil has been encouraged by those in authority and by economic stress, and animal, steam and electric powered traction have been swept from our roads and even from the farms.

In 1930 80 per cent of the draught power on farms in the United Kingdom was provided by animals. In 1949 the percentage had dropped to 15 per cent and if a census was taken in this year of grace the figure would be lower. The figures regarding road transport must be similar, for one can journey for many miles without casting eyes upon a horse. As regards road transport and traction on the farms, we have put "all our eggs in one basket." If the supply of oil ceased, or was reduced substantially, transport and traction would come to a halt. The consequence to the national economy would be catastrophic, for having pledged ourselves to oil we have omitted to preserve any alternative which could be operated and expanded immediately. Up till a few years ago there were many steam-powered vehicles and horses at work on the roads. Our roads, railways and docks were built with their aid, land was reclaimed and made productive, and the air was not fouled with lethal fumes.

During the two world wars, when oil was in short supply, horse transport played a vital part in the national economy. We could not have managed without it and, indeed, during World War II the volume of animal transport had to be increased considerably in many towns.

After the war, memory is apt to be short; our horses were condemned to a holocaust at the shrine of the Moloch oil, and steam and electric vehicles were deemed to be anachronistic impediments to progress and they were swept from the roads.

All our eggs were placed in one basket and at the mercy of the internal combustion engine, which can be called to a stop by a dissident voice in a foreign land. Recent events have shown the fallacy of depending entirely on an exotic source of power and the stupidity of casting aside that which is indigenous. If we still had our horses our present troubles would be ameliorated to a great degree.

Horses can be an economic asset to the country. They live off the land, they fertilise the soil, are self-supporting from the age of two years, and if managed well they grow into money. The sale of one or more each year will pay a tenant farmer's rent.

Initial outlay on horses is low when compared with that of a tractor. From the time of purchase a tractor is a constant expense and its capital value depreciates inexorably.

Horses increase in value for at least five years and they derive their sustenance from the land. They have served British agriculture and commerce well in the past and can do so in the future. They may be our salvation again. Farmers and transport contractors should retain an adequate reserve of living horse-power and in the national interest they should be encouraged to do so.

GENERAL ARTICLES

THE AVOIDANCE OF X-RAY INJURY

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THE dangers of over-exposure to X-rays and allied radiations have been stressed in the medical press, and this has drawn attention to those risks which are inseparable from the practice of diagnostic radiology, and to the appropriate protective counter-measures which can be adopted. The only uncertainty that remains concerns the actual amount or dose of radiation which may be tolerated without ill-effects. Authorities differ on this point, but it is noticeable that with accumulated experience successive estimates have become increasingly conservative, and the recommendations on protection correspondingly more severe. The latest publication in this field, the report of the Medical Research Council on "The Hazards to Man of Nuclear and Allied Radiations," is even more stringent than most of its predecessors, since it emphasises the need to consider all the sources of ionising radiation to which the population is exposed before defining a permissible figure for the dosage received from X-radiation alone.

The appearance of this report provides a timely reminder of the imperative need to examine the precautions necessary in veterinary radiography. There is little doubt that many of those concerned are not sufficiently aware of the need for precaution, and that some entirely disregard the risks involved. Whether this imprudence is due to ignorance, or to an optimistic, and ill-founded, belief that the volume of work undertaken is insufficient to justify anxiety is immaterial, since neither attitude is excusable. In particular, it should be remembered that the subordinates called upon to restrain the animals are generally exposed to greater dangers than the person who operates the controls. The veterinary literature is remarkably silent on these matters, and a paper by Henny (1953) appears to be the only relevant contribution in the veterinary periodicals. It is hoped that the present article may be of some value in drawing attention to the dangers that exist, and to the counter-measures that are available to provide protection; it will be obvious that it makes no claim to originality or to special authority, which, indeed, the authors would specifically disclaim. Fortunately, authoritative information and comment are available both in the report already mentioned and in numerous other publications. A short list of useful references is appended and particular mention of some of these is made in this article.

The nature of the injury which may be sustained from over-exposure to X-rays varies greatly and is conditioned by the amount and nature of the radiation, by the portion of the body exposed, and by the period over which the dose was received. It should be recognised that although the effects are cumulative, the response is also influenced by the intervals between exposures.

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Descriptions of the resulting lesions are provided by Colwell and Russ (1934) and Abraham (1954), among others, and it is not necessary, in the present context, to describe the various forms. In general, the effects may be defined as local or generalised, and within each category there are acute and chronic varieties. All tissues of the body may be involved but the skin and blood are affected most frequently. In addition to these somatic effects, and in some ways surpassing them in importance, are the genetic consequences which may follow irradiation of the gonads. Great care must be taken to avoid injury to these parts, particularly in young people.

The menace of X-rays is increased by their insidious nature for not only are the rays themselves invisible, but their effects may be delayed. Faulty procedures may be practised for years without producing manifest injury so that when the effects at last appear, perhaps years after the last exposure, it is unlikely that the damage can be arrested, far less reversed. (See, for example, " American Martyrs to Science through the Roentgen Rays," by P. Brown, and " X-ray and Radium Injuries," by Colwell and Russ.)

Mention has been made of the efforts undertaken to define a permissible dosage level at and below which radiation will be tolerated without immediate or delayed ill-effect. This cannot be determined with precision since so many variables are involved and, although many estimates exist, none has been universally accepted. A unit, the roentgen or r, has been defined in which dosage may be measured. The definition need not be given in a paper of this nature and it is probable that it is wiser to avoid any quantitative indications, but it is worth noting that the permissible doses recommended by the International Commission on Radiological Protection (1954) is 0.3 r per week on blood-forming organs, gonads and eyes. It has been suggested (Lorenz, *et al.*, 1947) that for women the permissible daily dose delivered to the ovaries should be only 0.02 r and it is stated (e.g., Quimby, *et al.*, 1946) that the local exposure to the fingers and hands should never exceed ten times the permissible dose. (The I.C.R.P. recommended only five times.) In interpreting these figures it will be of assistance to recall that the intensity of the main beam, three feet from the target of an X-ray tube operating at about 50 kv, is of the order of 9.3 r per minute per milli-ampere of tube current.

With average installations three sources of radiation have to be considered —the primary beam, leakage in other directions from the tube, and scattered radiation arising from all objects in the path of the beam. The primary beam constitutes the most obvious danger and for this reason it is most likely to be recognised and guarded against in practice. Its coverage is restricted in the manufacture of the tube. Although rays are emitted in all directions from the focus on the target, only those that impinge upon a restricted area or window in the tube lining escape. Thus the beam is regulated by the size and relative position of the two areas—focus and window; even so, it is too widespread for safety and in practice it is further restricted by the use of limiting cones or diaphragms of absorbent material placed in its pathway. These adjuncts will be referred to again but, as will be seen, they must always be employed to ensure

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that no one places his unprotected body within the area covered by the primary beam except in the case of the person undergoing a radiographic examination of that part. Elementary as this precaution may be, it is often ignored as is attested by the frequent appearance on veterinary radiographs of hands and arms grasping and restraining the patient.

In the manufacture of the tube care is taken to ensure that no rays can find exit except through the window, and leakage from other parts should not occur. It is wise to test each unit for reliability in this respect (White, *et al.*, 1943), especially as many installations are already old and possibly faulty. An unsuspected leakage forms a very serious hazard since it permits the passage of a primary beam in a direction and in a region where no danger is anticipated.

The third source of radiation is provided by every object within the path of the beam. Each obstruction, including the patient, gives rise to some scattering of the beam in all directions. The proportion which continues on its course and the proportion which is scattered are determined by the wavelength of the original beam and also by the size and composition of the intervening object. This scattering effect is recognised by a blurring of the image and provides the reason for the use of grids to absorb this radiation when dealing with bulky parts. The potential danger it constitutes is more important than any loss of quality in the radiograph.

Scattered radiation is softer, that is, more readily absorbed, than the primary radiation and therefore protection against it is obtained more easily. It must be recognised that constant or recurring exposure is just as dangerous as exposure to the direct rays. Binks (1943) has determined an approximate expression for the intensity of the scattered radiation. From this expression it is easy to show that the permissible dose can be received in a few minutes at a point close to the patient and this has been confirmed by direct measurement (Osborn, 1955). Fortunately, as the rays diverge, their intensity diminishes rapidly according to the law of inverse squares; hence it follows that distance alone provides a measure of protection. The rapid drop in intensity with distance from a point source is shown in Fig. 1.

With these facts in mind the measures which can be adopted to provide protection may be considered. It will be found that they are of two classes. In the first category are those measures that are appropriate to all classes of radiography; in the second, those peculiar to the special circumstances of veterinary practice.

The first and most obvious aim must be to restrict the number of exposures that are performed. This may be done in two ways: by restricting the use of radiology to those cases in which the technique is essential for diagnosis or prognosis and secondly, by improving the efficiency of each examination. With regard to the first point it must be admitted that X-rays are at present used in many cases when the clinical diagnosis should require no additional support and the technique is used to impress, or more often placate, an over-anxious owner. Such unnecessary examinations should be refused. On the other

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hand increased attention to details of exposure and dark room technique will do much to reduce the frequency with which repeat exposures are required. Repetition may be avoided in some cases by more care in positioning and restraint; in others by more attention to past experience. Many operators would derive much advantage, and also effect considerable economy if they compiled a list of exposures and noted the quality of the films obtained. Another useful

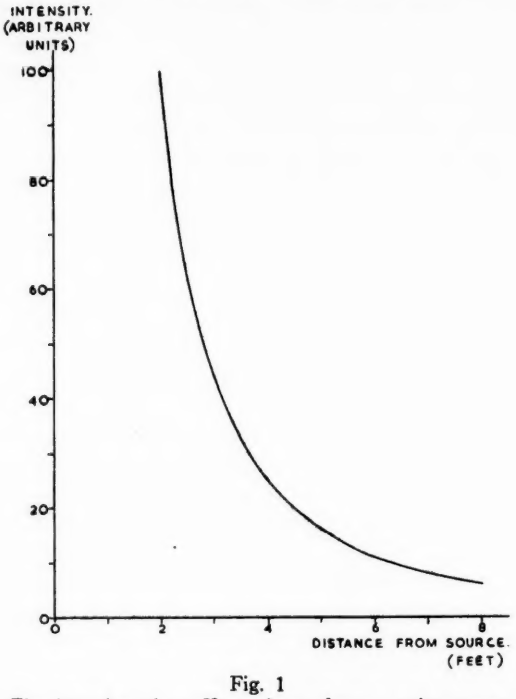

Fig. 1
The intensity of an X-ray beam from a point source plotted against the distance from the source.

procedure is to secure bilateral films whenever possible and thus avoid the duplication that occurs later when control is required for comparison.

A further general precaution is to reduce the exposure to the minimum by avoiding the use of grids and of slow film unless these are absolutely necessary. In veterinary practice fast screens and film will provide acceptable results on most occasions, perhaps even with improved definition, since the reduction of the exposure time and the corresponding reduction in movement is often of great benefit with apparatus of low power.

The insertion of an aluminium filter close to the source may be considered; this will cut out much of the softer radiation and should considerably reduce the superficial dosage without greatly affecting the film-blackening quality of the residual radiation beam (Martin, 1947). This practice does not appear to be adopted in veterinary radiography very often, but it is worthy of trial.

Perhaps the most important of the general measures concerns the use of cones or diaphragm to reduce the field covered by the beam; this reduces the danger not only from the primary beam but also, in corresponding degree, from the secondary or scattered radiation. Above all, where it is absolutely essential to restrain an animal by hand, a small cone or a restricted diaphragm will at least ensure that with proper centring the assistant is outside the line of direct rays. A valuable routine is to keep the smallest cone in position, and although it must be replaced when larger parts are to be examined, constant supervision should be exercised to ensure its return as soon as possible; painting the larger and more dangerous cones in a conspicuous colour is useful since it draws attention to neglect of this precaution.

The additional difficulties experienced in veterinary radiography arise through the need to control patients who are often unco-operative and frequently aggressive. This also provides the greatest danger for the obvious method of control is the active manual restraint of the animal in the required position. Those called upon to do this will be exposed to radiation. Before considering how to overcome this difficulty it is as well to place the problem in its true perspective and to recognise that in veterinary practice the principal concern must be for the welfare of those taking part in the examination and only to a lesser degree with the patient. Fortunately, it is necessary only rarely to consider the danger to the patient of excessive radiation; most animals are protected against superficial injury to some extent by the covering of hair and the exposures they are likely to receive are rarely sufficient to produce injury; some protection against delayed effect is also provided by the relatively short span of life of many species. When accidental damage has been reported (e.g., Neumann-Kleinpaul and Zeller, 1955) it has been as the result of experimental procedures. The possibility of producing genetic injury might be worth considering when dealing with breeding animals and the effect of X-rays on the fœtus by repeated examination of pregnant animals should be remembered (Boddie, 1946).

It is the risk to the personnel to which most attention must be directed. The operator of the controls is relatively safe; he is placed at some distance from the X-ray tube and, if necessary, he can be guarded easily by a protective screen. Those holding the animal are much more vulnerable and it is essential that the practitioner recognises his responsibilities to them. The most obvious and the most effective way to overcome this danger is to administer a sedative or anæsthetic to the animal so that it can be handled and positioned without the need for restraint during the actual exposure. The newer anæsthetic and sedative agents reduce both the risks to the patient and the inconvenience to the operator, and the possibility of employing one or other of these drugs should be considered in every case. The extra inconvenience may be slight since in many cases anæsthesia merely anticipates what would, in any case, be indicated by the result of the X-ray examination.

At present it is often the practice to safeguard assistants by requesting the owner to restrain the animal or by allocating the duty in rotation. Unfortunately

the owner is unlikely to perform this task efficiently and it may, in fact, be beyond the capabilities of one person unaided. Rotation is also not very effective unless there are sufficient helpers available to make it of real benefit. All too frequently, despite good intentions, it becomes the custom for the same people to perform this task. It is difficult to reconcile either practice with recent recommendations advocating the avoidance of radiography in medical practice where only minor conditions are involved. Whoever restrains the patient, it is essential that protective clothing should be provided and worn. It must be admitted that the clothing is not very satisfactory. The gloves are clumsy and prevent adequate control of a struggling animal, while aprons, though less inconvenient, are heavy and cause fatigue when worn for any length of time. Although these articles and, in particular, gloves give only partial protection from the main beam and may contribute to a false sense of security (Osborn, loc. sit.), it is to be regretted that more use is not made of them; often they are only worn when new and discarded when the novelty is gone. (Recent work in America [Archer, 1955] with fabric of spun lead glass promises protection without discomfort.)

A device that may be worth consideration is a lead-covered box which can be placed over the animal, but permits the passage of the head and limbs through a large opening at each end which is guarded by a series of overlapping lead rubber flaps. The tube is centred within the protected area and the walls stop most of the scatter so that the limbs may be held with safety. Considerable use has been made of this device even though it has certain drawbacks. It is heavy and clumsy and, unless rather large, it interferes with the chest when the patient is in the dorsal position and is likely to frighten a nervous animal.

So far all mention of fluoroscopy or screening examinations has been avoided. Undoubtedly these constitute the greatest threat (Barclay, 1934; Taft, 1941; Sievert, 1947, and many others). It is relatively easy to avoid danger when making radiographs but it is difficult to achieve a similar degree of safety when screening unless elaborate and expensive precautions are taken. These restrict the fluoroscopist by their somewhat unwieldy nature (Chamberlain, 1943). These requirements may be mentioned but first it is as well to consider the actual value of screening to the average practitioner. Few veterinary surgeons have either the facilities or the scope to become proficient in its use. It would appear that screening is employed as a rapid and cheap substitute for radiography of such conditions as fractures and the detection of foreign bodies and its real potentialities in the investigation of dynamic processes are largely ignored. In these circumstances it seems wiser to discontinue the practice entirely.

Those who wish to continue should ensure that examinations are made only when absolutely necessary and that they are of the minimum duration. Great attention should be paid to securing proper adaptation of the eyes by using a fully-darkened room and spending at least 15 minutes in total darkness or in a dim red light. If this practice is adhered to it will be found that the beam

intensity may be reduced and yet the image will appear brighter, enabling a diagnosis to be made in a fraction of the time formerly required.

It is important to make sure that the operator is not exposed to radiation for it is easy to forget the danger when engrossed in the study of the screen. The apparatus should be so constructed that the beam cannot overlap the fluorescent screen which is covered in lead glass. To ensure this, the movements of the screen and tube should be co-ordinated and the lighted part of the screen kept within the margin of the glass. There is considerable exposure to scattered radiation, at a point where its intensity is high, and protective material must be constantly between the observer and the source of all radiation, whether primary

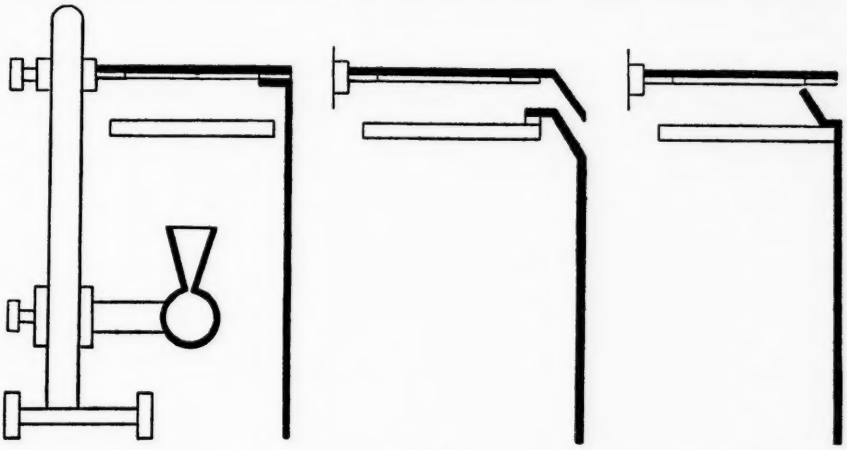

Fig. 2

A schematic diagram showing some ways in which protective material, equivalent to 1 mm. lead, can be arranged to protect a fluoroscopist.

or secondary. A number of alternative methods of doing this are illustrated in Fig. 2. These can be used instead of, or in conjunction with, gloves and apron. Palpation of the part under investigation may involve direct exposure of the practitioner's hands to the primary beam (Stevenson and Leddy, 1937).

It is advisable to maintain a check upon the exposure received. This may be done by wearing a sensitive film which can be examined periodically for evidence of exposure (Quimby, loc. sit). Alternatively, the facilities offered by the Radiological Protection Service at Sutton, Surrey, may be utilised.

It is a sound precaution to undergo regular blood examinations since quite often over-dosage is indicated first by alterations in the differential and total cell counts. These examinations and their interpretation should be done by experts. Usually where there is evidence of over-exposure it is sufficient to cease X-ray work for a time to restore full health, but competent advice should be sought always. It should be noted that some doubt about the usefulness of blood examinations has been expressed recently (Loutit, 1955).

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The authors hope that their remarks do not make it appear that all X-ray work is attended inevitably by frightening risks. In actual fact it is recognised that reasonable alertness and caution are sufficient to avoid any danger, but, as Sievert (loc. cit.) has remarked, propaganda and instruction are the most important measures for preventing radiation injuries, and the most efficient protection arrangements are of little value if those working with X-rays do not appreciate and understand the risks to which they are exposed. The truth of this is illustrated by the records of 70 patients with radiation injuries who were treated in an American hospital between 1939 and 1942 (Uhlmann, 1942). Fifty per cent of the patients were not professional radiologists but had been engaged in X-ray diagnostic work. Only 4 per cent of the injured were radiologists. The latter had been practising their profession for periods ranging from 20 to 40 years.

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AN INDIGENOUS BRITISH HORSE

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I BEGAN a study of the native ponies on Exmoor in 1946 and this was continued in the Department of Anatomy of the Royal (Dick) Veterinary College, Edinburgh, in collaboration with Mr. J. G. Speed from 1949 to 1953. It was undertaken because the herds of Exmoor ponies had been so reduced by the effects of the war that the true native animal was likely to become extinct.

The first step was to breed from as many ponies of the traditional type as were left. The next step was to make an approach to the authorities concerned with the preservation of the Mountain and Moorland pony breeds, so rightly considered a national heritage, to get information about their origins and history. It was then disclosed that the history of none of our native British ponies has ever been recorded and that no records of the herds existed except in cases where attempts had been made to alter them by crossing. Apart from the report of the committee appointed by the president of the Board of Agriculture and Fisheries in 1912 to advise him " whether and if so, what measures can be adopted for the improvement of mountain and moorland breeds of ponies," there was, in 1946, no source of reliable information about the different breeds. There still appears to have been no basic study made of any native pony breed, other than the present Edinburgh research on the Exmoor pony, since Prof. Cossor Ewart carried out his well-known investigations into the origins of horses at the beginning of the century. On the other hand, popular books and pamphlets on horses with either a sentimental or commercial bias but with no scientific authority, have been published in their hundreds. The committee which was appointed to advise the president of the Board of Agriculture and Fisheries on the " improvement " of native pony breeds consisted of six men whose report was written from the commercial angle of those times and was concerned with the use of the stock as a foundation from which to breed animals for polo and the hunting field, and the report refers briefly and without any description of their characteristics, to the Mountain and Moorland stallions " pure and simple." It is tantalising to read of these native stallions, then so plentiful but never described except in the phrases of the breeder of domestic horses. The need for the conservation of native livestock was not then understood, perhaps because the supply was considered to be inexhaustible, and with good intentions the foundation pony herds of the country were in numerous cases adulterated under the name of " improvement." This could have been excusable if we had been assured that all horses and ponies are of common origin, but since this is by no means certain, and the progress of equine degeneration indicates the contrary, most of us are beginning to realise that this policy of mongrelising has almost lost us our foundation stocks. Prof. Cossor Ewart, Regius Professor in Natural History in the University of Edinburgh, had a wealth of material at his disposal but he too overlooked the great significance of pure native stock and the importance of using authentic animals of known breeding. In the experiments at Penicuik his research specimens

were merely described as " Shetland, Iceland, Norwegian, Highland, New Forest, and Exmoor ponies; a half Arab mare, a small Clydesdale "—and so on.

A good deal of publicity has been given to the " Breeding back " experiments with horses lately undertaken at Munich, and the conclusions drawn from the results of mongrelising on a large scale seem to have been accepted in this country, due perhaps to the absence of any comment from a British authority with knowledge of native ponies or their breeding. It is safe to say that from lack of proper study of them, no one has really known the anatomical and genetical characters of typical native ponies, and it is the hill farmers only who have learned the types by tradition. It is therefore not surprising that the interpretations of the results of the Munich and Penicuik breeding experiments should differ fundamentally. Prof. Cossor Ewart became convinced after many years of research work in pony breeding and study of fossils, that horses and ponies were of multiple origins, while at Munich it has been claimed that in one or two generations the common ancestor of the horse has been re-created in the form of the Tarpan. The Tarpan, however, probably never existed as a real entity. This problem of the Tarpan, as Prof. Nehring pointed out in 1884, is a " queer one." Like Prof. Cossor Ewart's Celtic pony the Tarpan has no family history, and the only drawing from a living example, a picture by Borisow drawn from a one-year-old mare, shows very clearly that it was not the wild horse that was discovered in 1879 by the Russian explorer, Col. Prejvalsky. This picture was later on copied by Schreber in his Naturgeschichte der Säugetiere, and would appear to have been used by Col. Hamilton Smith to illustrate his work on the wild horse. Later still, in 1888, Carl Vogt, Professor of Natural History, Geneva, wrote of the Tarpan as the " degenerate horse of Asia," and Professor Brandt, one of the highest zoological authorities in Russia, was of the opinion that the Tarpan was " a perfectly common young steppe horse." To-day, both the Celtic pony and this Tarpan would be dismissed as mongrels by an anatomist or a pony breeder as there are no records of their parentage nor of any pure-bred progeny, nor do they conform to a distinct type, living or fossil.

In his popular account of the natural history of the horse, R. Lydekker found no reason why the early British horses should *not* have been derived from the native prehistoric breeds, and he pointed out that Darwin found it impossible to feel sure that all our breeds were descended from a single species. From the great amount of fossil evidence available in our museums, much of which has never before been examined from this point of view, it is impossible to avoid similar conclusions. The true wild horses of Central Asia, as well as those which had an infusion of foreign blood from domestic escapes, were well known by generations of hunters and travellers, but it remained for Col. Prejvalsky to secure one of the typical wild horses for scientific examination. Had he visited Exmoor during his explorations it is more than likely that he would have called the attention of the scientists of his day to a native British horse living wild in open country and with a uniformity of behaviour, of size, and of colour pattern, at least the equal of the wild equidæ inhabiting the steppes and mountainous regions of Central Asia.

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PLATE I

Fig. 1

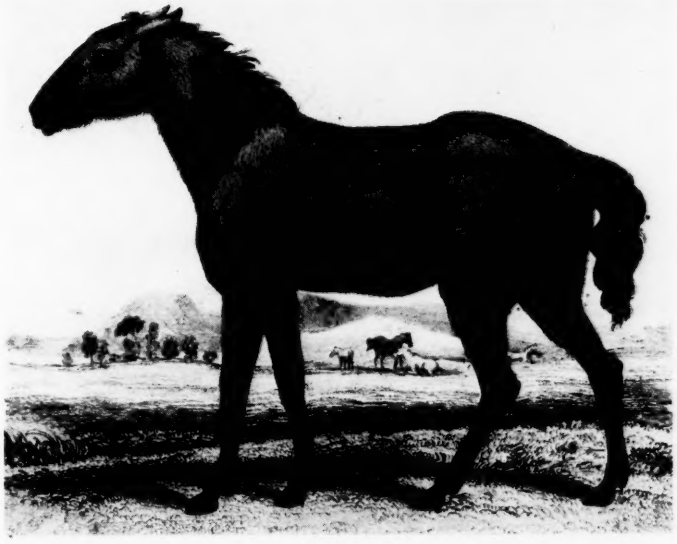

Fig. 2

Fig. 3

(*Article by Speed, page* 483)

KEY TO PHOTOGRAPHS

Fig. 1.—Typical native ponies. Western Island mare. *Copyright photo: The late Miss M. G. Best.*

Fig. 2.—The Tarpan wild horse. Primæval bay stock. Colonel Hamilton Smith, delt. 1841. "The degenerate horse of Asia." (*Vogt.*)

Fig. 3.—One of the typical wild horses. A young Prjvalsky bred in captivity. *By courtesy of the New York Zoological Society.*

Fig. 4.—A pony of cross-bred origins. An example of the debased animals which are constantly mistaken for some traditional type of Exmoor pony. *Copyright photo: M. G. Speed.*

Fig. 5.—The angle of the incisors allows the pony to make the fullest use of rough grazing. *Copyright photo: M. G. Speed.*

Fig. 6.—A good illustration of the native pony's teeth can be seen in the horse heads sculptered in reindeer horn from Mas-d'Azil. From "Palæolithic Man," R. Munro. Edinburgh: Oliver & Boyd. (After E. Cartailhac.)

Fig. 7.—Exmoor pony foals. The underparts of the body, the muzzle and the recognition patches on the buttocks are often of a very pale buff colour. *Copyright photo: M. G. Speed.*

Fig. 8.—The rest of the coat, too, is composed of hair and wool. *Copyright photo: M. G. Speed.*

Fig. 9.—A living reproduction of the cave men's art. *Copyright photo: M. G. Speed.*

Fig. 10.—In this robust, slow-maturing young pony the browlock is absent and during the first year the mane was erect. *Copyright photo: M. G. Speed.*

Fig. 11.—In the second year the mane became ragged, some of the tufts falling over on one side. *Copyright photo: M. G. Speed.*

Fig. 12.—Striping is not due to a difference in colour but rather to the arrangement of the hair. *Copyright photo: M. G. Speed.*

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PLATE II

Fig. 4

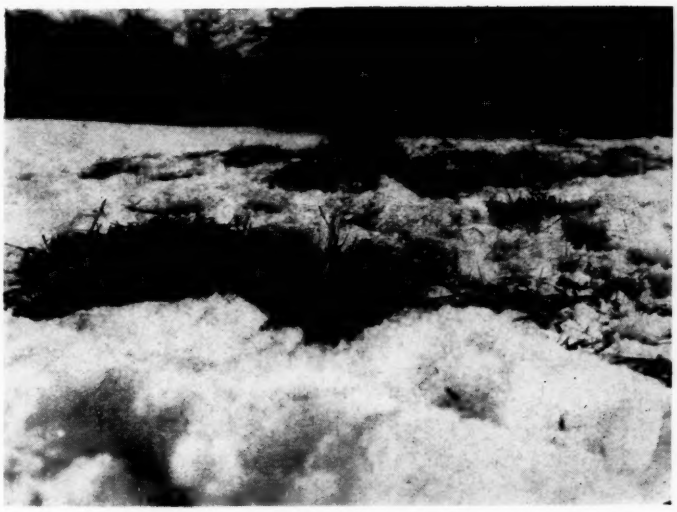

Fig. 5

(*Article by Speed, page* 483)

PLATE III

Portion of Reindeer-horn from Mas-d'Azil, sculptured into two Horse-heads (Col. Piette).
(After E. Cartailhac in *La France Préhistorique.*)

Fig. 6

Fig. 7

Fig. 8

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PLATE IV

Fig. 9

Fig. 10

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PLATE V

Fig. 11

Fig. 12

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That the distinctive characters of the Exmoor pony have not been recorded and the interest of the herds has not received the attention it deserves from zoologists and hippologists may be partly because their habitat did not encourage international hunters. Another cause is that specimens submitted have generally been " improved " ponies, the results of out-crossing, with the idea that a scientist deserved something of " better quality " than the common hill pony. In spite of that, Nehring, Cossor Ewart and Pitt Rivers all used an Exmoor pony as a type or standard for comparison. Dr. Scharff expressed the opinion that the British fauna forms the key to the solution of the problem of the origin of European animals. It is of interest that no horse fossils exist in the Gobi desert where Prejvalsky's horse was found, but in Somerset where the Exmoor pony still lives, the ponies have been there throughout recorded history, and in the Mendip caves horse fossils of at least two distinct kinds of horse, one of them the replica of the Exmoor pony, are numerous. The old Devon pack horse, now extinct, was built on the lines of the larger type of horse represented in the Mendip fossils. With a traceable lineage it has surely been an oversight that the Exmoor pony has not been more carefully studied. In fact, the Exmoor pony has been acknowledged in the past and by no less an authority than the British Museum. It was included in " A list of Described Species that are wanting to complete the Collection of British Mammals and Birds " which was added to the systematic catalogue of the specimens of the indigenous mammalia and birds preserved in the British Museum. This was in 1812, when the blight of mongrelising had not descended fully on the Exmoor herds, and pure-bred unspoiled indigenous ponies would still be obtained readily. Shortly afterwards, however, in 1819, the Forest of Exmoor was sold by the Crown to Mr. John Knight of Worcestershire and large-scale attempts were made to " improve " the ponies by the usual method of cross-breeding, a practice that was deeply resented by the Exmoor farmers, a few of whom, fortunately, followed the lead of Sir Thomas Acland and continued to maintain the native stock in purity, though frequently using individual mares for crossing with other breeds. The produce of these crosses, being larger than the pure Exmoor, was not returned to the open hill but was sold, often for a very good price. The debased animals, which are constantly mistaken for some traditional type of Exmoor pony, became numerous during the agricultural slump of the 1920's and were the result of allowing the mongrel ponies to mingle with the herds on the hill. The pure stock, as an old Exmoor farmer pointed out, is recognised very easily " by the head," and the owners of the herds have no difficulty in distinguishing the animals of true native type from those of mixed ancestry. This mixture is known to consist of at least four recognised breeds or types of horses.

The general impression gained by the first sight of true Exmoor ponies on the hill is that they are perfectly proportioned and perfectly balanced. There is such completeness and harmony in their form and action that no part of the body attracts attention more than another. A pony that is described as having a large head or small quarters can be dismissed with the animal whose head

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appears to be small and fine. Equally, a noticeably short or long back denotes an infusion of alien blood. Apart from the colouring, which closely follows the colour pattern of many wild animals, the ponies, as would be expected, are built for speed and activity; there is plenty of heart room and great development of muscle, which has earned for them the name of " the Iron Ponies " in Germany. The face is long and the muzzle (always mealy-coloured in pure-bred ponies) is broad, with clear-cut black nostrils. The upper lip is very prehensile and muscular, and is used in working through rough grazing in the selection of chosen plants. X-rays have shown the molar teeth to be long, strong, and well spaced, and implanted at an angle which gives considerable grinding power. The angle of the incisors allows the pony to make the fullest use of poor grazing and a very important point is that, unlike browsing animals, the native horses do no damage by tearing out the roots of grass pastures, but in grazing they sever the blades of grass neatly like a machine. It is easy to tell the true native pony by this distinctive angle of the incisor teeth, the upper and lower teeth meeting evenly in a well-formed arch, never protruding forward, even in old age. A good illustration of the native pony's teeth can be seen in the horse heads sculptered in reindeer horn from Mas d'Azil. The " cingle " (a light ring round the eye) and the thick eyelids, the mealy muzzle and the small beard running along the lower jaw are also clearly indicated, and it is well to remember that not only primitive man but primitive woman and child too grew up with a practical knowledge of zoology and of anatomy and with an experience in dissection that can rarely be equalled by their present-day descendants. They expressed their knowledge of animal life in rock paintings and line drawings engraved on the cave walls.

In looking at an Exmoor pony of the true type, one notices that the tail is set on low and hangs close to the body; the long hairs are straight, and short hairs at the root of the tail form a fan or " snow shute "; the legs are clean except for a fetlock tuft in summer and a fringe of soft hair reaching upwards almost to the hock in winter. (The belief that native British ponies are " shaggy " all the year round is widespread.) The soles of the feet should be completely bluish black and there are no white markings, although the underparts of the body, the muzzle, and the recognition patches on the buttocks are of a pale buff colour. The head carriage is bold, the muzzle being raised when the pony is alert so that the jaws form almost a right angle with the neck. One of the most useful guides to the authenticity of a pony is the position of the hair whorl on the forehead. This is normally placed between the eyes, or above eye level. In cases of mixed ancestry the whorl appears to be low or confused, and there may even be two distinct whorls. The hair on the face is smooth, except that the cheeks and the deep jaws are covered with a mixture of hair and wool. The rest of the coat, too, is composed of hair and wool, and the colour of the coat ranges between a dark mouse dun and a dark brown. Bay does not appear to be a true native colour in hill ponies. Col. Hamilton Smith noticed that the mountain regions in all parts of the hemisphere " breed small horses of great vigour," but the bay stock, he said,

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"is nowhere a mountain race." Like most mountain animals, the Exmoor ponies are quick-thinking and vigilant, amazingly hardy and capable of enduring the severe tests consequent upon their mountain habitat. The normal height of adult animals (which mature very slowly), judging by the bones of prehistoric and modern ponies, is 50 inches, and the girth behind the elbow is as much as 67 inches. Well-sprung ribs are characteristic of the true breed; closing in of the ribs often comes with cross-breeding. Perhaps the best indication of a true native pony is the eye. This has a clearness and a quality of sincerity and self-reliance which can only be described as *serenity*.

In notes on the Munich experiments in "breeding back" horses, Herr Heck has said that there "appear to be no primitive domesticated horses of the Tarpan type that have preserved one of the most important points of their wild ancestors, namely the short, upright mane," but the Edinburgh work has shown that by breeding from those Exmoor ponies which most closely resemble the traditional type and which agree with the horses represented by fossil bones from Pleistocene deposits in Britain, France, Germany and Alaska, a primitive form can be regained. A colt born in 1953 is a living reproduction of the caveman's art and conforms to an astonishing degree with the little horses of the gravures and wall paintings of the Dordogne. In this robust, slow-maturing young pony the browlock is absent, and during his first year the mane was erect and gathered into tufts as in the asses and zebras. In the second year the mane became ragged, some of the tufts falling over on one side about half way up the neck, and as the summer coat came in, striping on the neck and back were apparent. This striping on neck, back and over the ribs is found in the ponies of the darkest colour, that is, the dark, almost purplish brown, over dun. The striping is not due to a difference in colour but rather to the arrangement of the hair.

It is the healthy qualities of the Exmoor ponies and the close resemblance of their skeletons to those of a British prototype horse that give significance to the research work in Edinburgh into the origins of a native horse which has for generations been the beast of burden on the hill farms of Exmoor. The farmers of Exmoor, unlike the eastern races of horsemen, have always been able to take the health of the native horse for granted, and while their treatment of the Exmoor pony violated most of the modern accepted rules of horsemanship, it must be remembered that a great part of our present-day system of horse-keeping is a legacy from the years of British rule in India and applies chiefly to the Arabs' horse. A Muslim tradition written in Urdu praises the horse as the noblest of beasts created for mankind to ride on, and according to Hindu legends the horse was created a winged animal but was deprived of his wings by Yoga and could no longer fly to far-off jungles in search of medicinal herbs. Less than 50 years ago Indian Syces, Muslim and Hindu, believed the chestnuts of horses to be the scars of the old wounds caused by the removal of their wings. The wingless horse is said to have entreated the sage Salihotra to write a book on the treatment of horse diseases, and this Sanskrit word "Salihotra" came to mean both horse and veterinary science in general, interesting evidence that disease was present in the earliest records and traditions of domesticated Eastern

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horses. On Exmoor, disease in the native horse is virtually unknown, but it occurs and increases where cross-breeding is practised in the herds. The true Exmoor pony seeks and finds medicinal herbs in his native environment at regular seasons of the year, and his choice of the native plants and leaves of trees has opened up an interesting avenue in research.

It was in an attempt to understand why the hill farmers had protected a primitive horse stock which merchants and fanciers despised that the task of research was undertaken, and only in the veterinary profession was found the ability to understand the significance of the implications of this study in animal origins, health, and economy, and the importance of their relationship to a domestic animal. Perhaps for that reason it was only the veterinary profession that was able and willing to help. It has certainly been unfortunate that, in the past, archæologists have frequently been left to deal as best they could with the identification of fossil bones, for the results have not always been happy, but in the course of the Edinburgh work, in which much of the pony breeding has been guided by the knowledge gained from X-ray comparisons between typical Exmoor pony mandibles and the mandibles of fossil horses, the belief expressed by Sir Charles Bell in 1841 has been confirmed. In his treatise on the Hand he entreats his readers to remember that he was " early and long devoted to the study of Anatomy; with a feeling (right or wrong) that it surpassed all other studies in interest and usefulness." Fifty years later the editor of *The Zoologist* affirmed the same belief. " We are convinced ourselves," he wrote, " that Comparative Anatomy is the best introduction to the study of the phenomena of Animal Life."

It has been the science of Comparative Veterinary Anatomy that has lifted the study of the Exmoor pony from its small beginnings in a rough stable on Exmoor, where a few native ponies were gathered ready for Bampton Fair, into the realms of pure research. The study of native breeds can never be a popular theme except among those who are unfettered by commercial obligations or ambitions, but no sponsored work could yield more gratifying or far-reaching results. It seems fitting to conclude a description of what is, and must be, a pioneering enterprise, with quotations from a paper by the founder of the Royal (Dick) Veterinary College, Edinburgh—William Dick—" On the Improvement of the Breed of Horses."

" It is a daily remark that the breed of horses is rapidly degenerating, and those who have the best opportunity for observing it are the most decidedly convinced of the fact," he wrote nearly a hundred years ago. " Many of what was considered the most useful sort have now entirely disappeared. The breed is quite extinct. Where, for example, do we now find the fine short-legged handsome cob whose action and strength enabled him to go any pace and to carry any weight that could ride? . . . The body of an animal is a piece of mechanism. . . . It is not enough that it is put in motion by the noblest spirit, or that it is nourished by the highest blood; every bone must have its just proportion, every muscle or tendon its proper pulley, every lever its proper length and arrangement, every joint its most accurate adjustment and proper

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lubrication; all must have their relative proportions and strength before the motions of the machine can be accurate, vigorous and durable. . . . If the bones want their due proportions, or are imperfectly placed, if the muscles or tendons want their proper levers, if the flexions of the joints be interrupted by the defectiveness of their mechanism—the animal must either be defective in motion or strength; the bones have irregular pressure, and, if they do not break, become diseased; if the muscles or tendons do not become sprained or ruptured, they are defective in their action; if friction or inflammation does not take place in the joints, the motions are awkward and grotesque. . . . From what has been stated it will be inferred that there is a necessity to endeavour to obtain those animals for breeding which approach as near as possible to perfection in their mechanism."

These words of William Dick's can be taken as a guide towards understanding the significance which underlies this research into the existence of a Native British Horse. In their own environment and uncrossed with foreign stock such horses do not degenerate. It was on such horses that famous specialised breeds were founded. To preserve them and to save them so that they may be used to arrest the progress of degeneration in these selected and specialised breeds seems reasonable, quite apart from their own irreplaceable value. First, however, we must be sure that we have not substituted some alien stock for that which was truly native. The onset and progress of degeneration would tell us this. Such negative means of proof would be slow and dangerous to the existence of the true natives. It is in the hope that some positive recognition of the form, habits, health and economy of a native British horse can be accomplished that this work is being done.

Acknowledgments

This work has been made possible by Professor Grahame, who extended to me the hospitality of the Department of Anatomy, the Royal (Dick) Veterinary College. My thanks are due to him and to the members of the staff of the College who have unfailingly helped and advised in the many aspects of the work. In addition to this, the problem of handling wild-living herds of ponies could have been insoluble without the willing and gallant support of the student body. I also thank Herr Hermann Ebhardt, whose study of the Exmoor ponies in Germany has provided us with such valuable information and commentary.

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THE RELATIONSHIP BETWEEN FERTILITY, HATCHABILITY AND MORTALITY IN FOWL

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POULTRYMEN view a poor hatch with dissatisfaction, not only because of the reduction in the number of chicks expected to be available, but because of the common belief that the survivors may manifest poor viability and egg production. Dunn, however (1921-22), failed to show that pre-natal mortality was correlated in any way with post-natal mortality over the first three weeks of the chicks' lives. Jull (1927) investigated the relationship between chick mortality and variations in the incidence of embryonic mortality, and concluded that the early rearing death rate was uninfluenced by differences in the percentage of embryonic mortality occurring before or after the 17th day of incubation. In Jull's data the hatching rate of fertile eggs is given as 72 per cent, but no instances of very high embryonic mortality after the 17th day are recorded. The average chick mortality over the three seasons for the three flocks recorded was 8.21 per cent over four weeks. When, however, Jull's first season's results only are considered, the embryonic mortality after the 17th day reached 75.5 per cent (i.e., above normal) and the chick mortality to four weeks approximated to 13.8 per cent of those hatched. In spite of Jull's conclusions, there would seem to be from his data some relationship between an abnormally high embryonic death rate after the 17th day and high early mortality in the chicks hatched whether or not hatching rates are subnormal. Dunn did not give details of the incidence of embryonic mortality in his flock, but it is implied that a normal incidence was experienced, i.e., approximately 50 per cent of the embryos died before the 18th day of incubation. Recently, Coles (1956*a*) has presented evidence showing that with poor hatching more female than male embryos die, but that this sex differential is not continued post-natally. Hays (1949) pointed out that high mortality among both sexes from day old to eight weeks is associated with a higher production rate from surviving females compared with that of pullets having a lower early rearing mortality in their families. It seems obvious that if it could be established that poor fertility or a poor hatching rate—or differences in the incidence of embryonic mortality—do adversely influence early or adult mortality, then some part of the common belief, i.e., poor viability, on the part of poultrymen would rest on fact, although the allied view on poor production would not, since, in view of Hays's findings, the egg production of survivors could be above normal. In view of the limited information available on the subject, an analysis of the records over seven years of a closed flock of White Leghorns was carried out to determine whether any relationship existed between fertility, hatchability and mortality.

Experimental

The birds have been maintained as a closed breeding unit since 1946 and the prime aims have been to breed a strain resistant to fowl paralysis with a high hatching rate and a high level of production. Each year's breeding stock of eight cockerel sires and approximately 100 pullet dams is selected by reference to the records of the previous generation on a family performance basis. The degree of success achieved has been described elsewhere (Coles, 1954). During the last three seasons all eggs failing to hatch have been opened and the age when the embryo died determined. This examination has enabled a check to be carried out on eggs appearing infertile under the candling lamp. The number of dead "germs" which had died within 48 hours of incubation and appearing as infertiles by candling indicated that if a strict comparison with the years prior to 1954 is to be attempted, the infertility rate shown by candling for those years should be decreased by about 2.5 per cent and the hatching rate of fertile by almost 3.0 per cent.

During 1955 and 1956 the flock was divided into four groups for the purpose of experiments with fishmeal from various sources and different protein supplements with a view to ascertaining their influence on hatching rates. In the former year one group within the flock received vegetable protein and synthetic B_{12}, another condensed fish solubles and vegetable protein, and the remaining two white fishmeal. In 1956 each of the four groups was supplied with white fishmeal from widely separated sources of origin. Records were maintained of the hatchability, fertility and mortality for all groups as well as the incidence of embryonic death. The wide differences in hatching recorded over this period provided additional data on the influence exerted (if any) by hatching rates on post-natal mortality.

Results and Discussions

The summarised records for the last seven seasons are set out in Table I. From this table it will be apparent that total mortality in the flock has shown a continued decline until 1955 and then an increase appears which is confined to rearing mortality. The main reason for this sustained reduction over the preceding years in the total death rate has been the decrease in deaths from fowl paralysis and leucosis. If the death rate excluding that from these diseases is considered, there is little change in the incidence of mortality throughout the seven seasons so far as rearing mortality is concerned with the marked exception of 1955. In the case of adult mortality (20 weeks to 500 days) there are no appreciable differences over the whole period if deaths from fowl paralysis and leucosis be excluded.

From these figures there appears to be no correlation between fertility and hatchability. This conclusion receives further confirmation from the detailed records of the separate groups recorded during the last two seasons, when the range of hatchability was greater than that annually recorded for the whole flock and in fertility approximately the same (Table II).

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The fertility levels recorded in Table I show no correlation with youthful or adult mortality rates and provide no grounds for the belief that infertility influences in any way post-natal mortality. Again, this conclusion gains further confirmation from the records of separate groups in Table II. When, however, the relationship between hatchability and mortality is considered there appears no correlation between adult mortality and hatching rates in the annual figures, but it does appear that the decline in hatchability in 1955 was associated with

TABLE I

Fertility, Hatching and Mortality Records over seven Seasons in a

Season	Infertility	Hatch of Fertile Eggs	Rearing Mortality (20 weeks)		Adult Mortality (20-71 weeks)		Pullet Chicks hatched
			(a) Causes other than leucosis and paralysis	(b) Leucosis and paralysis	(a) Causes other than leucosis	(b) Leucosis and paralysis	
	%	%	%	%	%	%	
1950/51	9.6	86	8.0	1.4	5.0	16.2	811
1951/52	18.0	78	8.0	7.8	4.6	4.5	1235
1952/53	14.0	76	6.8	1.5	3.8	7.8	992
1952/54	12.0	81	8.4	1.4	2.4	2.2	1143
1954/55	12.4	82 (79*)	4.1	0.0	4.1	0.7	1134
1955/56	16.0	66 (61*)	19.2	0.3	2.9	1.9	1262
1956/57	11.8	78 (75.8*)	8.2	0.0			1470

* True hatching rate. The remaining figures are judged on the candling test only for infertiles.

an increase in juvenile mortality. (It is interesting to observe that the high rearing mortality in 1955 had no effect on the adult mortality other than an association with a slight recrudescence of deaths from fowl paralysis which might have been fortuitous.)

This superficial conclusion that low hatchability is associated with an increase in rearing mortality among the chicks hatched is not endorsed when the 1955 and 1956 group results are examined in detail. These are shown in Table II. From this table it will be seen that while some instances of low hatching are accompanied by high mortality, there is no consistent relationship. Some comprehensive pattern does, however, become apparent when the causes of the poor hatching and the incidence of embryonic deaths are considered.

In 1955 the poor hatching occurred in the groups fed fishmeal (C and D) and the reason for the depression reported in detail elsewhere (Coles, 1956*b*) was ascribed to the presence of aerobic sporing bacteria in the meal capable of coagulating yolks. The opinion gained some credence from the fact that the major cause of the high juvenile death rate in these groups was attributed to yolk sac infection. Deaths from this cause in the remaining two groups (not fed fishmeal) were substantially lower and it is believed that they were primarily the result of cross infection at hatching time since the eggs were not segregated during incubation.

In 1956 when all groups were supplied fishmeal—but from widely differing sources of origin—it was concluded that the small depression in group C

and the greater depression in group D were in the main due to overheating the fishmeal during manufacture leading to degradation of the proteins. The details of the argument are also reported elsewhere but, on the evidence submitted, the low hatching was attributed to the toxic effect of the products of this degradation. One sample (group C) was found to contain a low level

TABLE 2

Fertility, Hatching Rates and Details of Rearing Mortality for 1955 and 1956

Group	Fertility	Hatching rate of Fertile Eggs	Total Rearing Mortality (to 6 weeks)	Rearing Mortality from yolk sac infection
		1955		
	%	%	%	%
A	91.1	74.2	10.1	4.1
B	82.5	69.4	13.4	5.6
C	86.9	54.7	31.8	11.0
D	85.0	56.8	15.4	7.1
		1956		
A	79.2	85.2	4.8	0.7
B	92.5	83.8	3.5	0.4
C	91.8	75.6	12.7	2.1
D	88.6	60.8	7.4	0.8

of aerobic sporing bacteria capable of coagulating yolk; those organisms—aerobic and otherwise—found in the remaining samples lacked this power. It will be noted from Table II that group C in 1956 experienced both the highest level of rearing mortality and percentage of deaths from yolk sac infection, but these levels while not approaching the extent of that found in 1955, were substantially above all other groups in 1956. But group D with the lowest hatching rate in 1956 had virtually a normal juvenile mortality rate and the few deaths attributable to yolk sac infection did not vary significantly from the other groups except group C.

An examination of the incidence of embryonic mortality indicated some similarity between that of groups C and D in 1955 and that for group C in 1956. All were characterised by a marked peak around the 17th/18th day of incubation—the feature being marked very much more strongly in 1955. In 1956 all embryonic death curves showed a high peak at 21 days although, of course, the actual number of embryos dying was appreciably greater as the hatching rate of the four groups decreased. It would seem that the rise in embryonic mortality around the 17th/18th days associated with normal levels of hatching is exaggerated when a high embryonic death rate is caused by the presence of

harmful pathogens. Other workers (Bushnell, Hinshaw and Payne, 1926, and Taylor, Gunns, Grau and Lepkovsky, 1953) have shown that frank disease may exert a depressing effect on hatchability, and Bushnell and his colleagues showed that this depression is associated with an abnormally high juvenile death rate.

Few workers presenting data on the effect of nutritional deficiencies on hatchability refer at any length to post-natal mortality. It would be fair to assume that the early death rate of chicks hatched from birds fed these deficient diets did not reach a level sufficiently unusual to call for comment. From the writers' own observations diets resulting in poor hatching through nutritional deficiencies do frequently appear to give rise to a number of second-rate chicks at hatching. The number never appears to exceed two per cent which, with the normal variation in hatching encountered at large hatcheries, is probably insignificant, and it is quite within the bounds of possibility that a number of such chicks would thrive if they were properly managed and fed. In this experiment it seems clear that, where the depression in hatching could not be attributed to the presence of pathogens or harmful organisms, the variation in hatchability had no effect on post-natal mortality. The data already presented indicates that the low hatching rates recorded in 1956 were associated with a rapidly rising embryonic mortality after the 18th day of incubation. If the intrusive effect of bacterial contamination in group C be excluded, then this late embryonic death rate would appear to be due to cumulative stress arising from the destruction of some factor in the fishmeal through overheating or, more probably, the presence of toxic products from degraded proteins from the same cause. Probably such stresses are associated to a limited degree with most diets—particularly with heat-treated animal proteins—and in this experiment the fishmeal was fed at double the rate normally given to breeding stock in this country. In spite of very high embryonic death rates immediately prior to hatching, no abnormal juvenile death rate could be traced to this condition, and no significant variation occurred with total embryonic deaths in the several groups varying by as much as 300 per cent—if the apparent effect of bacterial contamination be excluded.

It is concluded, therefore, that fertility levels exert no influence on mortality. It is submitted also that variations in hatching rates have no effect on post-natal mortality unless the cause of the depression is due to the presence of pathogens. It seems apparent also that variations in the incidence of embryonic mortality —apart from those associated with the presence of harmful organisms—have no relationship to early chick mortality thus supporting Jull's conclusions—with the exception stated.

Summary

An analysis of the fertility, hatching and mortality rates of a flock of White Leghorns was carried out to investigate the possibility of there being some relationship between them. The records afforded no grounds for believing that infertility exerted any effect on post-natal mortality. Poor hatching rates due to causes other than the presence of pathogens did not appear to influence juvenile or adult mortality. Neither did variations in embryonic mortality, whether

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hatchability was good or bad, seem to influence mortality adversely, although when the depression in hatching was attributed to the adverse effect of harmful organisms, this condition was associated with a marked increase in embryonic mortality around the 17th/18th day of incubation.

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GLYCYRRHETINIC ACID — A NEW USE FOR A SUBSTANCE EXTRACTED FROM LIQUORICE: A Preliminary Report

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Liquorice has been used in pharmacy from the earliest times, chiefly as a constituent of expectorant mixtures and as a flavouring agent to disguise the taste of bitter drugs. Some ten years ago another important pharmacological use of the drug was discovered. Revers (1946) found that patients receiving extract of liquorice in large quantities or over a long period showed increase in weight and puffiness of the ankles. Work done at Amsterdam published in a paper by Molhuysen, Borst and others (1950) showed that liquorice, given by the mouth to normal human beings, caused salt and water retention and an excessive loss of potassium. The hæmodilution resulted in extra work for the heart and the blood pressure was raised. These effects are the same as those shown after injection of one of the principles of the adrenal gland, deoxycorticosterone (known also as deoxycortone or D.O.C.A.).

Two physicians working independently in this country reported that patients receiving para-amino salicylic acid flavoured with extract of liquorice showed symptoms of disturbed water—and electrolyte—balance (Strong, 1951; Roussak, 1952).

Groen and others (1952) and Borst and his co-workers (1953) showed that the part of the extract of liquorice which possesses this DOCA-like action was glycyrrhizinic acid, which is hydrolysable into glycuronic acid and glycyrrhetinic acid. Commercial liquorice extract contains from 2 to 7 per cent of the calcium and potassium salts of glycyrrhizinic acid.

The hydrolysed product, glycyrrhetinic acid, has been used experimentally in the treatment of many diseases of humans. It has shown great promise in the treatment of certain skin conditions, where its action is comparable with that of cortisone and hydrocortisone. Its use as a substitute for these expensive drugs has resulted in great saving of money in some hospital dermatology departments (Adamson and Tillman, 1955).

In view of the economic factor in veterinary practice, there would seem to be advantage in using glycyrrhetinic acid in those cases in which we require a cortisone effect. But what are the actions of cortisone which we may want to reproduce by the administration of glycyrrhetinic acid?

Apart from replacement therapy in cases of endocrine insufficiency, there are three chief effects (Michaud, 1954), which might be summed up as: (i) an *anti-inflammatory effect*—hyperæmia, exudation and proliferation are diminished; (ii) there is an *analgesic effect* at inflamed sites; (iii) there is blocking of the immunological responses of the body.

Although it has been said that steroid therapy cures nothing, it is just as true to point out that it modifies every inflammatory reaction for better or worse. If the inflammation is due to an irritant which is actually present in the tissues at the time of inception of the steroid treatment, then the cortisone-like action will probably be for the worse, as it does not remove the irritant and lessens both the immunological reaction of the body and the laudable inflammation which is the body's attempt to deal with the irritant. In many cases, however, the irritant trigger mechanism, having started the inflammation, has ceased to exist, yet the inflammatory reaction carries on. It is in this type of case, and in allergic reactions, that steroid therapy and, by analogy, glycyrrhetinic acid therapy can produce dramatic results.

ACTH therapy, stimulating the production of cortisone by the adrenal glands, has been shown to be of use in certain skin conditions in animals (Halpin, 1955), and therefore glycyrrhetinic acid was given a trial in my practice.

The results in some conditions treated are as follows:—

(1) *Eczema in the dog.* There does not seem to be any indication for using glycyrrhetinic acid in the acute form of this condition, possibly because of the difficulty of obtaining penetration of the drug through the profuse serous exudates. In subacute and chronic cases, however, the frequent application of glycyrrhetinic acid in watery solution has produced dramatic cessation of all symptoms in 48 to 72 hours, even in cases resistant to other forms of treatment.

(2) *Miliary eczema in the cat.* A recent advance in the treatment of this troublesome condition has been the use of testosterone. Its use may be followed by unpleasant effects. All my cases, over a period of six months, have been treated with 0.5 or 1 per cent aqueous solution of the sodium salt of glycyrrhetinic acid. In all cases, symptoms have disappeared almost entirely within three days. It is possible that the condition may recur later, as its cause appears to be due to a

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basic endocrine imbalance, but the symptoms may be once again allayed by a repetition of the treatment.

(3) *Chronic otitis externa*—so common in dogs with pendulous ears, has been greatly alleviated, in many cases completely, by using the aqueous solution over a period varying between three and twenty days. In cases grossly infected with pus-producing organisms, suitable antiseptic treatment was used first.

(4) *Chronic proliferative conditions of the skin,* common in dachshunds, Scottish terriers and cocker spaniels. Trial of glycyrrhetinic acid in three cases has been most rewarding. There has been a regression of the proliferative changes in the epidermis, and after treatment of one of the cases for some weeks the whole area returned to normal.

(5) *Vascular keratitis (Pannus).* In three cases in which long-standing irritation has caused the proliferation of blood vessels, etc., into the cornea, collyria of the sodium salt of glycyrrhetinic acid (0.5 per cent) has initiated resolution and in one instance a complete cure was obtained.

(6) *Pigmented keratitis.* In one case of pigment deposition in the cornea of a pekingese, the application of similar collyria has shown promise, and there are now increasingly large areas free from pigment. It is too early, however, to be sure of the end results in this case.

In addition to the above conditions, there are a number of other disease processes in which cortisone has been reported to have yielded good results, and in which glycyrrhetinic acid and its salts might well be tried. They include: arthritis in the dog (treated by oral cortisone, Martin, *et al.*, 1954), excessive granulation tissue in the horse (Martin, *et al.*, 1954), traumatic arthritis in the horse (Bunn and Birch, 1955), and possibly the purpura group of diseases.

Cortisone has its uses in surgery. It provides the patient with a reserve against shock, and it is possible that glycyrrhetinic acid may prove useful also.

Method of Use

Glycyrrhetinic acid has given good results when used very sparingly. Solutions of the sodium salt at concentrations of from 0.2 per cent to 2 per cent have given almost identical results, and it would appear that the more dilute solutions will be the ones of choice. In ointment form, in a water-miscible base, 1 to 2 per cent of glycyrrhetinic acid is adequate.

It seems to be best for the drug to be in almost continuous contact with the affected tissues, by applying the solution or ointment several times daily for two or three days, rather than by less frequent applications over a longer period.

As expressed above, glycyrrhetinic acid and other substances of its nature are still at the stage of clinical evaluation. It is necessary that they be assessed qualitatively and quantitatively against the other better-known corticosteroids before any final conclusions can be drawn. From my own personal observations, as well as from reports of its employment in human medicine, I feel that it deserves well of further trial in a variety of conditions which we meet with in veterinary practice.

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AN ANNOTATION ON THE OCCURRENCE OF TUMOURS IN SHEEP

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With reports on two cases observed by the author.

A COMPARATIVE review of neoplasms should be of value in clarifying the nature of neoplastic diseases. It is, therefore, important that observations and results obtained in work with neoplasms be reported in the literature and thus be made available for consideration in investigations of this problem. The comparative rarity of tumours in sheep seems to justify recording the tumour cases found in autopsies at the Department of Animal Pathology, Faculty of Veterinary Medicine, Ankara, Turkey, during the years 1935-1955.

Tumours are observed less frequently in sheep and goats than in horses, cattle, dogs and cats (Akçay, 1953; Dobberstein, 1949; Feldman, 1932; Lombard, 1955; Newson, 1952; Pamukcu, 1954*a* and *b*). The inference that sheep and goats are more resistant to development of neoplasia than the latter animals is not necessarily correct, since the age of the various species at the time of observation must be considered before a conclusion can be reached. However, sheep do appear ostensibly to be relatively immune to carcinomatous proliferation, and there are few references in the literature to carcinoma in this animal (Courteau, 1935).

There are, indeed, few records of tumours of any kind in sheep. However, in her excellent review of the literature regarding tumours of domestic animals, Tamaschke (1951-52) stated that of 5,254 tumours of different animals of which she found records, 114 were of sheep. She also pointed out that the incidence of tumours in sheep in autopsy material was not higher than 0.8 per cent. However, slaughterhouse statistics showed that the percentage incidence of tumours in this animal varied from 0.004 to 0.02. She added that 43.8 per cent of the sheep tumours were benign in character and 56.2 per cent were

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malignant: She found the ratios benign: malignant tumour to be 1 : 1.7. She also stated that 72 (63.2 per cent) out of 114 tumours recorded were epithelial in origin. According to Dobberstein (1953) the percentage of incidence of adenoma in sheep is 29.8.

The sheep neoplasms and anatomical distribution given by Tamaschke (1951-52) are set forth in Table I. Feldman (1931) found 40 sheep tumours in a series of 404 collected from domesticated animals in the United States. All

Table 1 : Anatomic Distribution of the Tumors in Sheep given by Tamaschke (1951/1952).

Type of Tumors	Location of Tumors																			Total	
	Dig. system			Resp. syst.		Urinary Organs	Genital organs			Circulat. Syst.	Other organs										
	Upper part	Stomach-intestin	Liver-gall bladder	Nasal cavity	Lung	Kidney	Uterus	Udder	Testis	Heart	Eye	Endocrine system	Skin	Subcutis	Muscle	Bone	Spleen and lymph nodes	Other location		
Fibroma										1									1		
Lypoma			1							1									2		
Chondroma																3			3	7	
Myeloma																	1		1		
Sarcoma			9	1			1			1			1	1		6	2	3	25		
Leiomyoma							5												5	6	
Rhabdomyoma															1				1		
Mycsarcoma		1					1												2		
Papilloma			2																2	26	
Adenoma		2	4		26							2							34		
Carcinoma	1	1	18		5			1	1		2	3	2					2	36		
Mixedtumor					1	1													2		
Total	1	4	34	1	32	1	7	1	1	3	2	5	3	1	1	9	3	5	114		

sheep tumours were obtained from the slaughterhouse. Jackson (1936) found 39 sheep tumours out of a total of 593 in the South African collection at Onderstepoort.

The sheep neoplasms in the order of frequency as classified by Feldman (1931) and Jackson (1936) are given in Table II. Comparison between these findings is hardly valid, because the basis of classification is different and the number in each category is small. It is evident in this tabulation that epithelial tumours constitute more than half of the total number; but Willis (1948) claimed that epithelial tumours are relatively rare in sheep.

The distribution according to organs is given in Table III. The discrepancy in total numbers is due to failure to state the site in all cases. The greatest number were found in the adrenal by Feldman (1931), Mandon (1935) and Lombard (1955), and on the skin by Jackson (1936). As is apparent from Table I, Tamaschke (1951-52) found that the greatest number of sheep tumours reported were localised in the liver and gall bladder. Dobberstein (1955, 1955) also pointed out that 50 per cent of the carcinomas were observed in the liver. Davis, *et al.* (1933) stated that the percentage of epithelial tumours found in the sheep liver was six. Feldman (1932) found that 12 per cent of epithelial

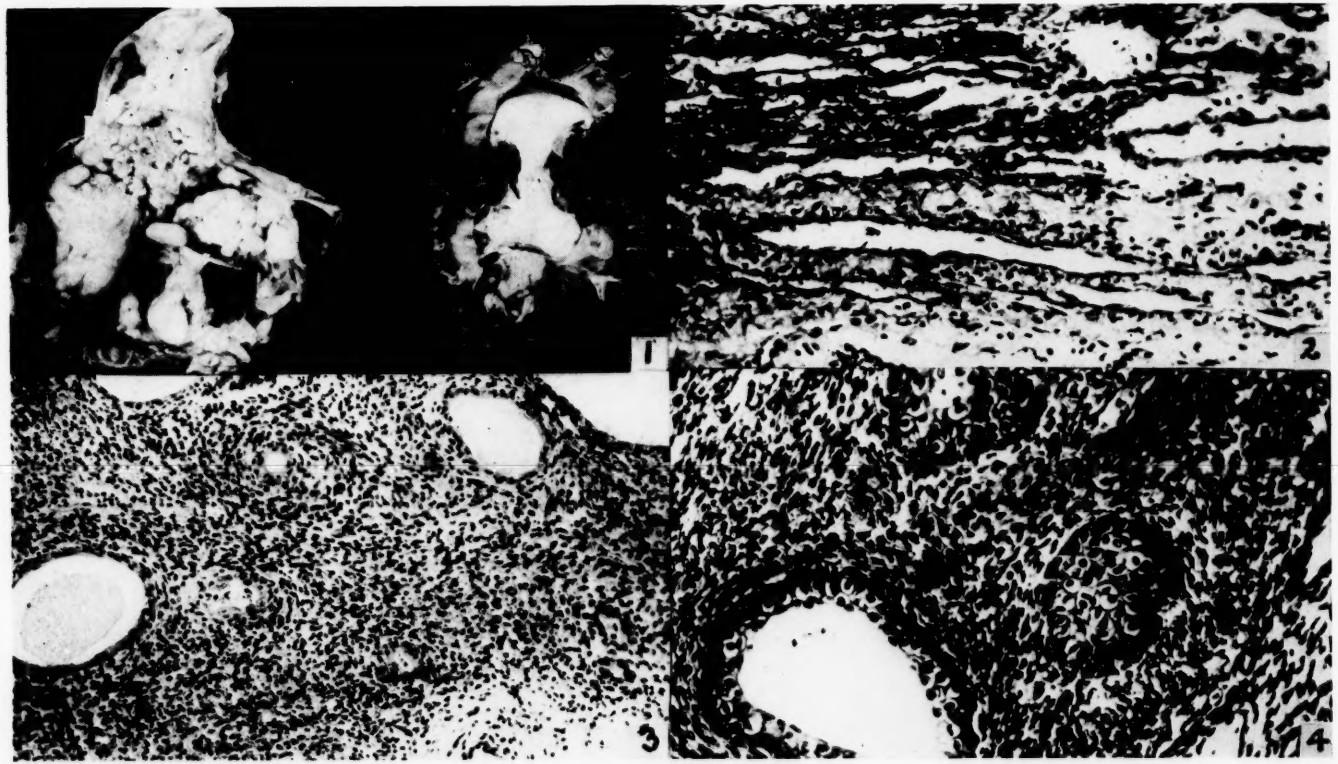

Fig. 1.—Embryonal nephroma of the kidneys of the sheep.

Fig. 2.—Embryonal nephroma with ill-formed blood channels. H&E. x 120.

Fig. 3.—Embryonal nephroma of the sheep, with both sarcomatous and adenomatous types of structure and polypoid projection of the growth clothed by a layer of young pelvic epithelium. H&E. x 75.

Fig. 4.—Embryonal nephroma of the sheep, with both sarcomatous and adenomatous types of tissue and undifferentiated epithelial clumps. H&E. x 120.

(Article by Pamukcu, page 499)

tumours occurred in the liver in sheep. According to Messow (1952-53) hepatic-cell adenoma is the most common epithelial tumour in the cow and sheep.

The ovine lung is prone to tumour-like adenomatous changes when acted upon by pulmonary nematodes and chronic infections but the number of reported cases of pulmonary neoplasms in sheep is very small. Therefore, they can hardly be considered as having statistical significance. In this connection, mention

Table II. Sheep neoplasms in the order of frequency as classified by Feldman (1931) and Jackson (1936).

Feldman		Jackson	
Carcinoma	17	Gland cell carcinoma	11
Lymphocytoma	6	Acanthoma	10
Adenocarcinoma	5	Lymphocytoma	4
Leiomyoma	2	Teratoid (embryonal)	3
Osteosarcoma	2	Thymoma	2
Lymphoma	2	Hypernephroma(benign)	2
Adenoma	1	Cornu cutaneum	1
Cystadenoma	1	Epithelioma (adenoid)	1
Epithelioma	1	Myxoma	1
Mesothelioma	1	Lipoma	1
Fibroma	1	Osteoma	1
Chondroma	1	Fibrosarcoma	1
		Endothelioma (hemangio)	1

Table III. The anatomical distribution of the sheep tumors according to organs given by Feldman (1931) and Jackson (1936).

Feldman		Jackson	
Adrenal	10	Skin	7
Liver	5	Lymph node	4
Lymph node	4	Liver	3
Bone and cartilage	3	Kidney	3
Eye	2	Lung	2
Skin	2	Adrenal	2
Uterus	2	Thymus	2
Lung	2	Stomach	1
Heart	1	Pancreas	1
Thymus	1	Thyroid	1
Thyroid	1	Spleen	1

should be made of the adenomatous epithelial proliferation of neoplastic type which occur in the lungs of South African sheep affected with jaagziekte. Dobberstein (1937) gives the following figures of malignant tumours in man and domestic animals that are lung carcinomas: human 4.16 per cent, equine 4.8 per cent, canine 4.11 per cent and bovine 5.99 per cent. These figures would seem to show that primary pulmonary neoplasms occur in approximately the same proportion in all species. In an excellent review of the literature concerning pulmonary tumours of domestic animals, Monlux (1952) stated that only 12 cases of primary pulmonary neoplasms out of 134 were reported in the sheep. The diagnoses were as follows: adenoma 4, adenocarcinoma 2, indurating adenocarcinoma 1, carcinoma 2, papillary adenocarcinoma 1, embryonal adeno-

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sarcoma 1, and mixed teratoma 1. The incidence of lung tumours in sheep is low because most animals are slaughtered before they reach old age. Swine, which are usually killed at less than one year of age, had no pulmonary neoplasms reported among them. According to Monlux " the dog, horse and cow, which attain an old age, showed the highest incidence. The average age for pulmonary neoplasms in domestic animals is as follows: dog 9 years, horse 16, cow 10, and cat 11. Two affected sheep were listed as old, a third as four to five months, and another as four years." Monlux found that the right lung of domestic animals showed the higher incidence of primary pulmonary tumours. Krahnert (1953) found 120 cases of pulmonary carcinoma in domestic animals in the literature. He expressed the opinion that most carcinomas in animals arose from bronchial mucous glands; and that multiple focal tumours involving one or more lobes and one or both lungs were the most frequently described lung lesions. In Krahnert's series two primary lung adenocarcinomas in sheep were present.

The ovine olfactory mucous membrane is prone to tumour or tumorous proliferation which occurs endemically. Nieberle, quoted by Tamaschke (1951-52), expressed the opinion that carcinoma of olfactory mucous membrane was probably due to inhalation of arsenic-containing gas. Drieux, *et al.* (1952) stated that several cases of epithelioma of the ethmoidal mucosa occurred in a flock of old sheep in the course of a few years. They considered the possibility of a contagious cancer, similar in type to the tumour described among equines and bovines, but they did not give the percentage incidence of epithelioma in this flock. Recently, Cohre (1953) reported that " in four flocks of black-headed sheep in Germany, endemic adenopapilloma of the olfactory mucous membrane was detected in 2 to 15 per cent of the animals." The tumours could be transmitted to healthy sheep by cell suspensions and by cell-free filtrates by instillation into the ethmoidal region. He suggested that the causal agent might be a virus.

According to Flir (1952-53), primary tumour of the kidney is more common in man than animals. The percentage incidence of kidney neoplasms varies from one species of animal to another. Dobberstein (1937) gives the following figures for kidney tumours: equine 1.4 per cent, bovine 7.11 per cent, canine 1.13 per cent, and man 1.4 per cent. Krook (1954) reported a statistical analysis of 440 cases of carcinoma in the dog encountered in autopsies at the Department of Pathology, the Royal Veterinary College, Stockholm, during the years 1935-1952. Only two carcinomas (0.45 per cent) out of 440 were found in the kidney. This indicates that carcinoma of the kidney in the dog may not be as common as claimed by many workers. Stünzi (1953) reported three cases of carcinoma of the kidney in dogs at the ages of 3, 7 and 10 years. In a review of veterinary literature regarding primary kidney tumours of domestic animals, Flir (1952-53) gives the following figures: equine 9.4 per cent, bovine 2.3 per cent, sheep 6 per cent, swine 60 per cent, and cat 2.5 per cent. These figures indicate that primary kidney neoplasms are more common in swine than in any other species of domestic animals. Tamaschke (1955) reported that out of 95 tumour cases in rabbits, 15 were found in the kidney. She states that

the rabbit shows a great susceptibility to kidney tumours. Except in the case of swine, epithelial tumours of the kidney were more frequently noted in them than in other types (Flir 1952-53). Carcinomas including adenocarcinoma and carcinoma medullare are common in the domestic animals. Jackson (1936) reports two kidney carcinomas in sheep. Adenoma occasionally occur in the kidney of all species of animals. Among Flir's compiled data on 16 adenomas of kidney of animals only one adenoma was obtained from sheep.

As far as I am aware there is no acceptable record in the literature of hypernephroma (Grawitz tumour) in domestic animals.

Flir (1952-53) claimed that sarcomas were rarely noted in the kidney of the animals. Feldman (1932) had occasion to examine a malignant capillary hæmangioma from an old ewe. The right kidney and both lungs were extensively involved.

Embryonal nephroma (nephroblastoma) undoubtedly comparable with the embryonic tumours of the human kidney occurs in the pig (Feldman, 1932), cow and sheep (Feldman, 1932; Flir, 1952-53), rabbit (Tamaschke, 1955), hare, rat and fowl (Feldman, *et al.*, 1948; Willis, 1948) and the dog (Savage, *et al.*, 1954). Many names have been applied to the embryonic renal tumours: adenosarcoma, myosarcoma, mixed tumour, Wilms tumour, embryoma, embryonic nephroma and nephroblastoma (Willis, 1948). As Willis (1948) stated: "these, of course, do not imply different kinds of tumours, but merely structural variants or different notions regarding histogenesis." Feldman (1932) and Flir (1952-53) believe embryonal nephroma is the most common renal tumour of swine. Flir (1952-53) reviewed the cases of embryonal nephroma in domestic animals published prior to 1952 and found a total of 104. He added that only three cases of embryonal nephroma among the 104 were encountered in sheep. These cases were reported by Jackson (1936). Flir (1952-53) concluded that 2.6 per cent of all sheep tumours are embryonal nephroma.

The scarcity of neoplasms in sheep recorded in the literature might suggest that sheep possess a marked racial insusceptibility to new growth, but the fact that the majority of them are slaughtered at a relatively early age must be considered before a conclusion can be reached in this regard.

Method and Material

The material in the present investigation was obtained from autopsies during the years 1935-1955. During this period, 573 sheep that died from various causes were sent to us for post-mortem examination. Tumours were found in only two sheep out of 573 consisting of 150 male and 423 female sheep. The average age of the 573 sheep was about two years. The specimens taken from the autopsies were fixed in ten per cent formalin. Paraffin sections were stained with Hæmatoxylin-Eosin and van Gieson.

Case Reports

Case 1: Merino ram, four years old, with unknown history.

Gross Examination: (126/1942 on March 2, 1942).

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The post-mortem specimen was a well-nourished Merino ram. The liver was enlarged. There were dark blood-red tumours of soft consistence in the liver. By pressure the blood could be expressed from them. The tumours measured 5 mm. in diameter. There were abscesses in the lung and iliac lymph nodes. No metastasis was present.

Histological Examination: The liver tumours showed multiple, irregular, newly-formed blood spaces which had infiltrated into adjacent tissues. The cells lining many of the cavities pushed into the lumen from one side. Frequently, solid nests of cells presented a compact arrangement simulating sarcomatous structure. The type cell varied somewhat in appearance. Many cells were oval or polyhedral. The cytoplasm took a slightly basic stain. The nuclei were oval and contained considerable chromatin in the form of fine granules. In some sections mitotic figures were numerous.

Diagnosis: Angiosarcoma.

Case 2: Ewe, native breed, two years old, with unknown history.

Gross Examination: (185/1955 on December 11, 1955).

The post-mortem specimen was that of a well-nourished individual. Bilateral growths occurred in the kidneys. The right kidney was greatly enlarged and cystic. By incision a bulky mass of greyish-white tissue with deep lobulations was noted. There was evidence of extensive replacement of the renal tissue (Fig. 1). Many small cysts containing a semi-clear fluid were exposed when the tumour was cut. The growth was extensive and practically obliterated the renal tissue. A solitary nodule was present in the pelvis of the left kidney. It was greyish-white in colour and elongated in shape (Fig. 1). Metastasis to the regional lymph nodes or to distant organs was not present.

Histological Examination: The structure of the tumours varied greatly. The growth consisted of cellular parenchyma, which was irregularly interrupted by well-defined septa of adult connective tissue in which were numerous, ill-formed blood-vessels (Fig. 2). The parenchymal cells were in some sections spherical or spindle-shaped and with a definite sarcomatous appearance. In other sections they formed irregular, adenomatous, tubular-like structure (Figs. 3 and 4). The cells which lined the irregular, duct-like structures often exhibited a tendency to project into the lumen in a papillary fashion. The epithelial cells varied from cuboidal to columnar. Cystic cavities which were occasionally present were usually lined with a single layer of cuboidal epithelial cells. The lumen was often filled with a substance which stained pink with eosin. The epithelial structure showed great diversity of form, including undifferentiated epithelial clumps, tubules in all stages of formation, and proglomeruli (Figs. 3, 4). Polypoid projections of the growth into calices were clothed by a layer of young pelvic epithelium.

A thick layer of fibrous connective tissue was present between the parenchyma of the kidney and the neoplastic tissue. Destruction and replacement of

the renal tissue of the right kidney was brought about through expansion of the tumour. The structure of the kidney was largely reduced.

Diagnosis: Embryonal nephroma.

Discussion

Although an occasional neoplasm has been described in sheep, tumours are observed less frequently in this species of animal than in others (Feldman, 1932; Courteau, 1935; Mandon, 1935; Newson, 1952). Tamaschke (1951-52) pointed out the percentage incidence of tumours in sheep in autopsy material was not higher than 0.8. Of a total of 573 sheep we examined at autopsy in 20 years at the Department of Animal Pathology, the Faculty of Veterinary Medicine, two (0.4 per cent) had tumours. Our findings confirm the results of previous workers (Courteau, 1935; Mandon, 1935; Tamaschke, 1951-52). Although a large proportion of sheep are slaughtered as lambs or young adults, it is equally true that a large number of old ewes are examined at necropsy each year, and that frequency of neoplastic growth is less than that which obtains for dogs and cattle of comparable ages. It is suggested that the evidence seems fairly conclusive, therefore, that the sheep possess some insusceptibility to neoplastic growth.

We found that two sheep out of 573 autopsied had tumours. One of the neoplastic growths was angiosarcoma in the liver of a male sheep at the age of 4 years. So far, two cases of hæmangio-endothelioma in sheep were recorded in the literature (Davis, *et al.*, 1933; Roemmele, 1951). The hæmangio-endothelioma case described by Roemmele (1951) had metastasised to the spleen. In the other case (Davis, *et al.*, 1933) metastases were present in the lung and kidney. In our case there was no metastasis.

The second tumour we observed was an embryonal nephroma of the kidneys of a ewe aged 2 years. Bilateral growths occurred (Fig. 1). Embryonal nephroma has been observed in the sheep, cow, pig, rabbit, hare, rat, fowl and dog (see above). Flir (1952-53) reviewed the cases of embryonal nephroma in the domestic animals published prior to 1952 and found a total of 104. He stated that only three cases of embryonal nephroma were encountered in sheep, and concluded that 2.6 per cent of total sheep tumours were embryonal nephromas.

The comparative rarity of tumours in sheep seems to justify recording the two cases of tumour found in our laboratory.

Summary

(1) Of a total of 573 sheep examined at autopsy in 20 years at the Department of Animal Pathology, the Faculty of Veterinary Medicine, Ankara, two (0.4 per cent) had tumours.

(2) One of the neoplastic growths was angiosarcoma in the liver of a male sheep at the age of 4 years. There was no metastasis.

(3) The second tumour was an embryonal nephroma in the kidney of a female sheep at the age of 2 years. The tumours were bilateral. Metastasis to the regional lymph nodes or to distant organs was not present.

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ON A NEW SPECIES OF THE NEMATODE GENUS *IMPALAIA* FROM THE CAMEL (*CAMELUS DROMEDARIUS*) IN EGYPT

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THE nematode genus *Impalaia* was erected by Mönnig (1924) for the species *Impalaia tuberculata* Mönnig (1924) which was found in the intestine of the antelope, *Æpyceros malampus,* commonly known as impala in South Africa. A further species has since been described, namely, *Impalaia nudicollis* Mönnig (1931) from the intestine of the Blesbok, *Damaliscus albifrons.* Mönnig (1931) tried to infest lambs by feeding larvæ of this parasite raised from cultures, but he was unable to get positive results. He concluded that it appeared as if *Impalaia nudicollis* was not transferable to sheep. Mönnig (1932), finding that these two species of parasites are very similar, carried out a comparative study on a large selection of specimens of *Impalaia nudicollis* with the co-types of *Impalaia tuberculata.* He concluded that there were distinct differences, the chief of which being the larger bursa and dorsal ray in *Impalaia tuberculata* and the different lengths of the spicules. This same study revealed to Mönnig that the tubercles on the anterior part of *Impalaia tuberculata,* which had been considered as a characteristic of this species, were mere artefacts. Daubney (1933) recorded *Impalaia nudicollis* from sheep, *Ovis aries,* in Kenya, giving a full description of the parasite and concluding that the absence of tubercles and the difference in length of dorsal ray and spicules could be taken as the main guide in diagnosing *Impalaia nudicollis.* Nagaty, *et al.* (1947) listed *Impalaia nudicollis* from the camel for the first time, but gave no description of the parasite.

The present work is concerned with a species of *Impalaia,* which was met with in the small intestines of the camel, *Camelus dromedarius,* in Egypt during the summer of 1953. The parasite infested mainly young camels, and was accompanied in the majority of cases with tapeworm infestation, namely, *Stilesia vittata* Railliet (1896), and *Avitellina* species. The infestation among camels with this parasite is by no means infrequent in Egypt.

Description of *Impalaia ægyptiaca* Sp. Nov.

Slender worms of a light red colour in the fresh state. In both male and female worms the cuticle is slightly inflated around the anterior extremity. This region of the cuticle, which is 0.10 to 0.13 mm. long in the males, and 0.11 to 0.14 mm. in the females, is transversely striated. When examined under higher magnification, these striations are seen as circular thickenings surrounding the body of the worm under the surface of the inflated cuticle (see Fig. 1). These circular striations give sometimes a false impression of a tuberculated appearance to this part of the parasite. The rest of the cuticle exhibits fine longitudinal striations.

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The mouth is surrounded by three small lips. The head is 0.032 to 0,038 mm. in diameter in the males and 0.034 to 0.046 mm. in the females. The club-shaped œsophagus is 0.38 to 0.52 mm. long in the males and 0.46 to 0.62 mm. in the females. The nerve-ring is, in the males, situated at 0.32 to 0.33 mm., and in the females at 0.32 to 0.37 mm. from the anterior extremity. The excretory pore was not readily observed, but when located it was found to be situated at 3.8 to 4.2 mm. from the anterior extremity.

Male. Male worms may be identified easily by virtue of the well-developed bursa. The length of the body ranges from 8.5 to 11.5 mm., while the breadth

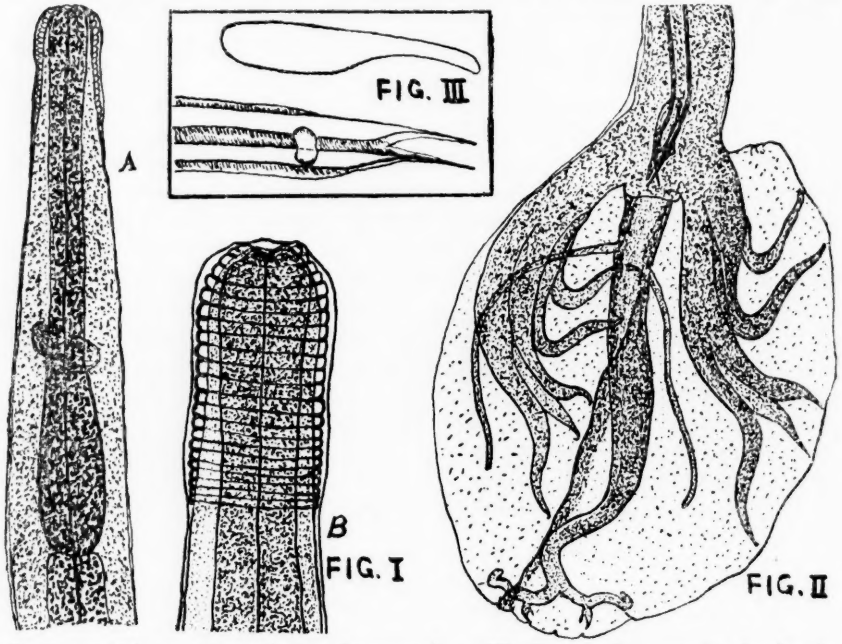

Fig. I. *Impalaia ægyptiaca.* A—Anterior extremity, x 180. B—Anterior extremity showing the circular thickenings under the surface of the inflated cuticle. x 350.
Fig. II. Posterior extremity of male, ventral view, showing the bursa with its rays. x 100.
Fig. III. Attachment near distal end of the spicules and the gubernaculum. x 400.

attains its maximum just in front of the bursa and varies from 0.13 to 0.16 mm. The bursa is hood-shaped, with well-developed lateral and dorsal lobes, although the latter is not distinctly separated. The rays are typical of the genus. The roots of the ventral and lateral rays are compact, and together give the impression of forming one main, thick trunk. The rays of both groups reach the margin of the bursa. The ventro-ventral ray is smaller than the latero-ventral ray, and both are directed forward. The antero- and medio-lateral rays have a common trunk, nearly equal in length. The latter ray runs outwards to the margin of the bursa, curving slightly backward, while the former runs to the margin of the bursa, curving forward. The postero-lateral ray is distinctly

longer than the previous two rays and runs backwards along the margin of the bursa. The externo-dorsal rays are long and slender, arising from the dorsal stem at 1/7 to 1/6 of its length from the base, but they do not reach the margin of the bursa. The right side ray originates a little nearer to the base than the left one, and is 1/5 to 1/4 longer. The dorsal ray is long, stout at its base, and tapering distally, where it bifurcates into two branches, which run almost at right angles to the common trunk. Each of these gives off an inner branch from its mid-point. These two inner branches run directly outwards to the margin of the bursa, and each bears a small inner median, spine-like process. The tips of the four dorsal branches are not digitated and end in a simple recurvity. The dorsal ray exhibits the characteristic bend towards its end, as described in *Impalaia tuberculata* (see Fig. 2). Its length, measured in a straight line to the point where it bifurcates, ranges from 0.6 to 0.7 mm. There are two brownish filiform spicules of equal length, measuring 1.3 to 1.6 mm., with an average of 1.4 mm. Their sides are ridged and the two spicules are attached together, near their distal ends, by a sclerotised, knob-like structure (see Fig. 3).

Female.—Female worms are 15 to 21 mm. long and their maximum breadth, which is attained just in front of the vulva, ranges from 0.14 to 0.17 mm. The vulva is situated in front of the anus at 0.182 to 0.26 mm. from the posterior extremity. The length of the vagina ranges from 0.115 to 0.130 mm., and this leads to an ovejector, 0.4 to 0.6 mm. long. The single uterus is usually packed with eggs, disposed in no special manner. The anus is located at 0.052 to 0.068 mm. from the tip of the tail. The posterior extremity of the female narrows just behind the vulva and ends in three conical processes, formed by a terminal and two subterminal lateral papillæ. There is a single ovary, which is located in the anterior part of the body. The eggs measure 0.065 to 0.073 mm. by 0.037 to 0.041 mm., and are segmenting when laid.

Comparison of the Species of Impalaia

In the following comparative table the principal measurements of the two previously-known species of *Impalaia* have been taken from the original descriptions of Mönnig (1924, 1931 and 1932). Measurements of *I. nudicollis* collected from sheep, and diagnosed as such by Daubney (1933), are also cited for comparison with those recorded for *I. ægyptiaca.* Morphological characters which indicate reasons for regarding *I. ægyptiaca* as a distinct species are also indicated in the table. It will be seen that *I. ægyptiaca* differs from both previous species in several of its measurements, notably in the length of the body and of the œsophagus in both sexes, as well as in the position of the anus and the length of the ovejector. *I. ægyptiaca* also differs markedly in certain morphological characters, these being:—

(1) The mouth in *I. ægyptiaca* has three small lips which exhibit no papillæ, while in *I. nudicollis* Mönnig (1931) these bear two lateral and four submedian papillæ. Daubney (1933) gave no account of the mouth in *I. nudicollis* he collected from sheep in Kenya.

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TABLE I

Showing comparison of the Species of Impalaia

Organs	I. tuberculata from antelope Monnig (1924)	I. nudicollis from blesbok Monnig (1931)	I. nudicollis from sheep Daubney (1933)	I. aegyptiaca from camels Soliman (1954)
Cephalic inflation in both sexes.	No tubercles & transversely striated.	No tubercles & transversely striated.	No tubercles or papillae. Transverse striation not mentioned.	No tubercles & transversely striated.
Mouth.	------	3 lips bearing 2 lateral & 4 submedian papil.	------	3 lips & not papillated.
Head diameter in microns.	40 - 45	46 - 59	males up to 30 females up to 45	males 32 - 38 females 34 - 46
Oesophageal length in microns.	440	male 440 - 480 female 440 - 520	350 - 450	male 380 - 520 female 460 - 620
Oesophagus shape.	------	Cylindericsl.	------	Club-shaped.
Nerve - ring.	Behind middle of oesophagus.	Male 370 - 410 Female 330 - 390	------	Male 320 - 330 Female 320 - 370
Excretory pore.	------	Not located.	------	3.8 - 4.2 mm.
Female:				
Length in mm.	18	14.8 - 16.7	11 - 13	15 - 21
Breadth in microns.	120	140 - 160	up to 200	140 - 170
Anus pos." "	40	67 - 74	55 - 60	52 - 68
Vulva " " "	100	240 - 260	200	182 - 260
Vaginal length"	------	------	Combined length,	115 - 130
Ovejector " "	900	------	of both 500-700.	400 - 600
Eggs in microns.	60 X 30	63-74 X 39-46	78 X 40	65-73 X 37-41
Male:				
Length in mm.	7.2 - 7.5	7.5 - 8.2	7.5 - 9	8.5 - 11.5
Breadth in microns.	120	110 - 120	100	130 - 160
Bursa.	Hood-shaped	Large; dorsal lobe not marked off.	Long & voluminous; with developed lateral lobes.	Hood-shaped; dorsal lobe not marked off.
Dorsal ray.	Characteristic bend.	No bend.	Characteristic bend.	Characteristic bend.
Dorsal length in mic.	------	------	Total 400 - 500	Stem 600 - 700
" ray branches.	Tips curved back.	------	Short & terminations bifurcate.	Not bifurcated & tips curved back.
Spicule-length in microns.	600	910 - 980	900 - 1000	1300 - 1600 average 1400.
Spicule shape	Proximal ends bifid, curving backwards.	equal filiform; not bifid.	No terminal hooks.	No terminal hooks; attached near distal end and their edges are ridged.
Gubernaculum length in microns.	------	94 - 100	85	82 - 100
Gubernaculum shape.	Boat-shaped & bright brown.	Simple shaped.	Boat-shaped & pale brown.	Boat-shaped & light brown.

(2) The cephalic inflation in *I. ægyptiaca* is similar to that in both *I. tuberculata* and *I. nudicollis* Mönnig (1931), while Daubney (1933) made no mention of the transverse striations, and only stated that no tubercles or papillæ were observed. Probably he had not at that time read Mönnig's (1932) correction about these in *I. tuberculata.*

(3) Spicule length in *I. ægyptiaca* exceeds by far that given for the other two species. Such a difference can scarcely be looked upon as variation accurring within the one species. The spicules also differ from those in *I. tuberculata* in having no hooks at their proximal ends, and differ from those in the two previous species, in having an attachment near their distal ends, and their edges are ridged.

(4) Dorsal ray.—Although the stem of this ray in *I. ægyptiaca* agrees with the description given for that in *I. nudicollis* by Daubney (1933), it differs markedly from the latter in being over 30 per cent longer, and in that the termination of its branches are not bifurcated, but end in a simple recurvity. It also differs markedly from the dorsal ray in *I. nudicollis* of Mönnig (1931) in showing the characteristic bend which is lacking in the latter.

(5) Externo-dorsal rays.—In *I. ægyptiaca* these arise from the dorsal stem at 1/7 to 1/6 of its length measured to the point of its bifurcation, while in *I. nudicollis* Mönnig (1931) they arise at about 1/3 of the dorsal stem. In the specimens of *I. nudicollis* described by Daubney in 1933, and in *I. tuberculata* Mönnig (1924), the point of origin of these is not given, but figures shown for both indicate that they arise from near the base of the dorsal stem in a similar fashion in both parasites.

Furthermore, Mönnig (1932) states that a comparison of specimens of *I. tuberculata* and *I. nudicollis* show that there are distinct differences between the two species, the chief being the larger bursa and dorsal ray in *I. tuberculata,* besides the different length of the spicules. On the other hand, Daubney (1933) shows the reverse as regards the dorsal ray, as he recorded for it a total length in *I. nudicollis* from sheep that ranged from 0.4 to 0.5 mm. and compared it with a 0.23 mm. dorsal ray length in *I. tuberculata* deducted from the original figure given by Yorke and Maplestone (1926).

However, until the range of variability in the previously-mentioned species is more accurately studied and a comparative examination of the original type specimens, the writer has no alternative but to regard the present specimens as representatives of a new species—*Impalaia ægyptiaca.*

Type-host.—Camel (*Camelus dromedarius*).

Location.—Small intestine.

Locality.—Cairo abattoir.

Type-specimens in Veterinary Research Institute, Egypt, collection No. 1, and paratype-specimens in British Museum (Natural History), helminthological collection No. B.M.N.H., 1954, 9.1.1—150.

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Acknowledgments

The writer wishes to express his gratitude to Mr. S. Prudhoe, British Museum (Natural History), for his willing help in the identification of tapeworm species recorded, and to Mr. W. G. Inglis, British Museum (Natural History), for examining the paratype-specimens mentioned in this work. Thanks are also due to Dr. A. W. Stableforth, Director of Veterinary Laboratory, Weybridge, for making available facilities for tracing literature needed, and to Dr. I. Abou Bakr, Director of Veterinary Laboratories, Egypt, for his interest in the work and encouragement.

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CORRESPONDENCE

Nuffield Orthopædic Centre,
Oxford.

October 23, 1956

To the Editor,

SIR,

For several years I have been engaged in a study of the hip condition in children known commonly by the names of coxa, plana, osteochondritis of the hip, Perthes disease or Legg-Calve-Perthes disease. I have seen some references to a similar condition existing in the hips of terriers—fox terriers, Cairn terriers and Irish terriers. Up until recently we thought that only the Danish pig had been supposed to suffer from this disorder which, by the way, in man is not related to the condition we recognise as slipped epiphysis.

As for the prosecution of our work it would be extremely important to be able to study the vascular pattern of the hip of terriers suffering from this condition we should be extremely grateful if any veterinary surgeon with such an animal under his care could communicate with us.

Yours truly,

J. TRUETA, M.D., D.Sc., F.R.C.S.,
Nuffield Professor of Orthopædic Surgery.

REVIEWS

VETERINARY PARASITOLOGY, by Dr. Geoffrey Lapage. Pp. xvi + 964 + 34 plates. Edinburgh and London: Oliver & Boyd Ltd., 1956. 63s. net.

"THIS book is about the parasitic animals that cause diseases of British farm stock." So starts chapter I. Despite the public health and increasing economic importance of parasitic diseases in farm animals there are relatively few modern books in the English language dealing with veterinary parasitology so that the appearance of a new British textbook is both timely and welcome. The subject of veterinary parasitology has grown enormously during the past twenty or so years and its literature has become so extensive that it is a matter of great convenience, if not of necessity, to have brought together within the compass of a single volume the main facts about parasites which surveys and research have brought to light. This latest arrival is a substantial volume of nearly one thousand pages and is produced in the excellent manner which we have come to associate with Messrs. Oliver and Boyd's workmanship.

The first two chapters, which form the introduction, deal with general principles of parasitism. The various types of animal associations are mentioned as are also the characters of the main groups of parasites, their life-cycles, routes of entry into the host, and the effects upon and reactions of the hosts. There follow twenty-eight chapters grouped into four parts which deal *seriatim* with the Nemathelminthes, the Platyhelminthes, the Arthropoda and the Protozoa. There is a general zoological account of each phylum and a classification of its members. This is followed by a consideration of the principal species belonging to each phylum, special attention being paid to those occurring in British live-stock. The morphology of each species is presented in a short description, reinforced by illustrations, sufficiently detailed for its recognition. This is followed by an account of the life history and biology of the species, its effects upon the host and the reaction of the host to the parasite, the disease symptoms, and the control and drug treatment. The author believes that, by presenting the information in this manner, the reader will be given "a picture of each species, not only as an individual in its zoological setting, but also as a species actively engaged at the present time in exerting its own particular economic effect on the world in which we live." The majority of his pen portraits are interesting, portrayed with care and thought, and well worth careful scrutiny.

When one considers the well of information to be found within the covers of this book it might seem discourteous to be hypercritical, especially when no claim is made for the volume to be a practical guide to clinical parasitology, but the reviewer believes that its usefulness would have been enhanced had more data on therapy been included as well as accounts of diagnostic procedures. This could have been done without increasing the size of the book if the author had jettisoned some of the rather unnecessary information on the fleas and lice and mites. In fact, that part of the volume dealing with the Arthropoda in general appears to contain fuller accounts than is the case with the other phyla and, because of this, it is out of balance with the other sections of the book.

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At the end of the book is a list of 736 references, which includes 25 personal communications, to the literature of parasitology selected with a view to enabling the reader to extend his knowledge of a parasite or group of parasites in which he may become specially interested. There is a good alphabetical index occupying 28 pages. The volume is primarily intended for veterinary surgeons and students, and Dr. Lapage has provided them with a comprehensive, up-to-date and authoritative textbook. Nevertheless, those interested in agriculture, zoology and human medicine will find much to interest them within its pages. In this present age when almost everything, be it bread, bus fares or books, is becoming more costly, the price asked, namely, 63s., for the volume, is by no means exorbitant and the wise purchaser will have the satisfaction of knowing that he has almost 4 lb. of good parasitological literature in his possession.

THE LONDON ZOO, by Philip Street. London: Odhams Press Ltd. Price, 16s. net.

THE London Zoological Gardens rank as a national institution and they are probably the oldest and most famous existing in the world. The Zoological Society of London was founded in 1826 largely owing to the enthusiasm of Sir Stamford Raffles whose genius and foresight added Singapore to the British Empire. The gardens were opened to the public for the first time on April 27, 1828, on a plot of Crown land in Regents Park.

The first three chapters of this book deal with the history of the Zoo from its origin to the present day. The story is concise and displays all the relevant facts relating to the various changes in establishment and administration. This makes extremely interesting reading. As is often the case in other bodies and institutions things did not always go smoothly, particularly in management and finance. These things only served as a stimulus to further effort and the magnificent collections of animals in London and Whipsnade are an obvious tribute to the efforts of past and present Fellows and officials of the Society.

Chapters 4 to 10 deal with the management and housing of the various species, vertebrate and invertebrate, kept in the gardens. There can be no doubt that the information which has been garnered at Regents Park has been of the utmost value to all those who are responsible for the care of wild animals which are kept in captivity. Chapter 10 deals with health problems. If animals are to be exhibited successfully then good health is essential, and the fact that the animals live longer in captivity at the London Zoo than they do under natural conditions, is a measure of the progress that has been made in the husbandry of captive animals and in veterinary science. Chapter 12 gives an account of the contribution that the Society has and is making to the advancement of scientific knowledge on the academic as well as the practical side. Tribute is paid to the pioneer work of William Youatt who was Medical Superintendent from 1833 to 1847. He was responsible for the supervision and treatment of the animals and for conducting examinations post-mortem to ascertain the cause of death. After Youatt's death the post of Medical Superintendent was allowed to lapse, regular examinations post-mortem ceased, and it was not until 1907 that another veterinary consultant was appointed.

In 1865 Professor T. H. Huxley drew attention to the fact that little use was made of the valuable anatomical material available. A prosector was appointed and from that time a great store of anatomical knowledge has been accumulated. Famous men have served in the Prosectorium and in addition to the anatomical studies pathological research has not been neglected. The Prosectorium has become a fount of knowledge of great value to the maintenance of health and the fight against disease.

Many of the buildings at Regents Park are old and, economically, some are not worthy of repair. The time has come when it is necessary to look to the future and plan a new Zoo with modern buildings. In a few years a new Zoological Gardens will arise from the ashes of the old. This book on the London Zoo will be a welcome addition to the library of all those who are interested in animals. The story is told well and the illustrations are excellent.

DIE KRANKHEITEN VON HUND UND KATZE (The Diseases of the Dog and Cat), by Werner Bachmann. Pp. 398. Grundrisse: Reinhardts, Veterinarmedizin.

FOR more than 20 years Dr. Bachmann has been the head of the Small Animal Clinic at the faculty of Veterinary Medicine at the University of Berne.

His book is a welcome addition to the few textbooks on this subject. It is of a reasonable size and price (about 25s. in this country).

It does not claim to be an exhaustive treatise on this subject but it should provide a concise and valuable work for students and general practitioners.

There is a general introduction. The format follows a systematic plan. The main part of the text is devoted to the diseases of the various systems of the body. Separate sections deal with infections and metabolic diseases.

A useful table of drugs is appended. There is a list of references in addition to those mentioned in the general text. As in all first editions, several minor inaccuracies occur in the text. These do not seriously detract from its use to the clinician.

NEWS

BENJAMIN WARD RICHARDSON Lecture. On Wednesday, November 28, 1956, at 2.30 p.m., at the Royal Society of Health's headquarters. "Food Poisoning in Man, with Special Reference to Meat and Meat Products," by R. Lovell, D.Sc., Ph.D., M.R.C.V.S., D.V.S.M., Professor of Veterinary Bacteriology, Royal Veterinary College, University of London.

Installation of New R.S.H. Chairman

AT a meeting of the Council of the Royal Society of Health held recently, Professor Harold Burrow was installed as Chairman of Council for the year 1956-57. He succeeds Dr. Albert Parker, C.B.E.

Professor Burrow is the first veterinary surgeon to occupy this position in the eighty years' history of the Society.

XUM

André Mayer Fellowships

The Food and Agriculture Organisation has established a number of Fellowships with the object of fostering research in the field of food and agriculture. These Fellowships will be called André Mayer Fellowships. The late André Mayer was closely associated with scientific research in France and in the international field, in relation to F.A.O.

The Fellowships will be awarded for advance training and the encouragement of research work in fields of particular interest to member countries and to F.A.O. as a whole.

Five or six Fellowships will be offered in 1956 and they will cover the whole F.A.O. field, i.e., agriculture, agricultural economics and statistics, fisheries, forestry, and nutrition. Awards will be given for periods up to two years, with the possibility of an extension to a maximum of thirty months, and payment is expected to be at the rate of 250 dollars a month. Further information can be obtained from the Secretariat of the F.A.O. National Committee for the United Kingdom, c/o Ministry of Agriculture, Fisheries and Food, 10 Whitehall Place, London, S.W.1.

NOTICE

MESSRS. ALLEN & HANBURY introduce Entavet Tablets. Entavet Tablets contain streptomycin and sulphaguanidine and are particularly convenient for the treatment of calf scours. The price is as follows:—Entavet Tablets, containing streptomycin sulphate 0.5 g. and sulphaguanidine 4 g. Container of 20 tablets (professional), 22s. 6d. each. Exempt from purchase tax.

ERRATUM

Reference to article by D. H. Hill on page 63, February, 1956. Page 64, line 25, should read "... little or no effect on titres due to natural infection."

Publishers' Notices

THE BRITISH VETERINARY JOURNAL, with which is incorporated THE VETERINARY JOURNAL, is published monthly, and copy for advertisements should be in the hands of the advertisement manager not later than the 20th of the preceding month, if proof is required. Tel.: Temple Bar 3386.

Letters for the Journal, literary contributions, reports, notices, books for review, exchanges, new instruments or materials, and all matter for publication (except advertisements) should be addressed to the Editor.

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